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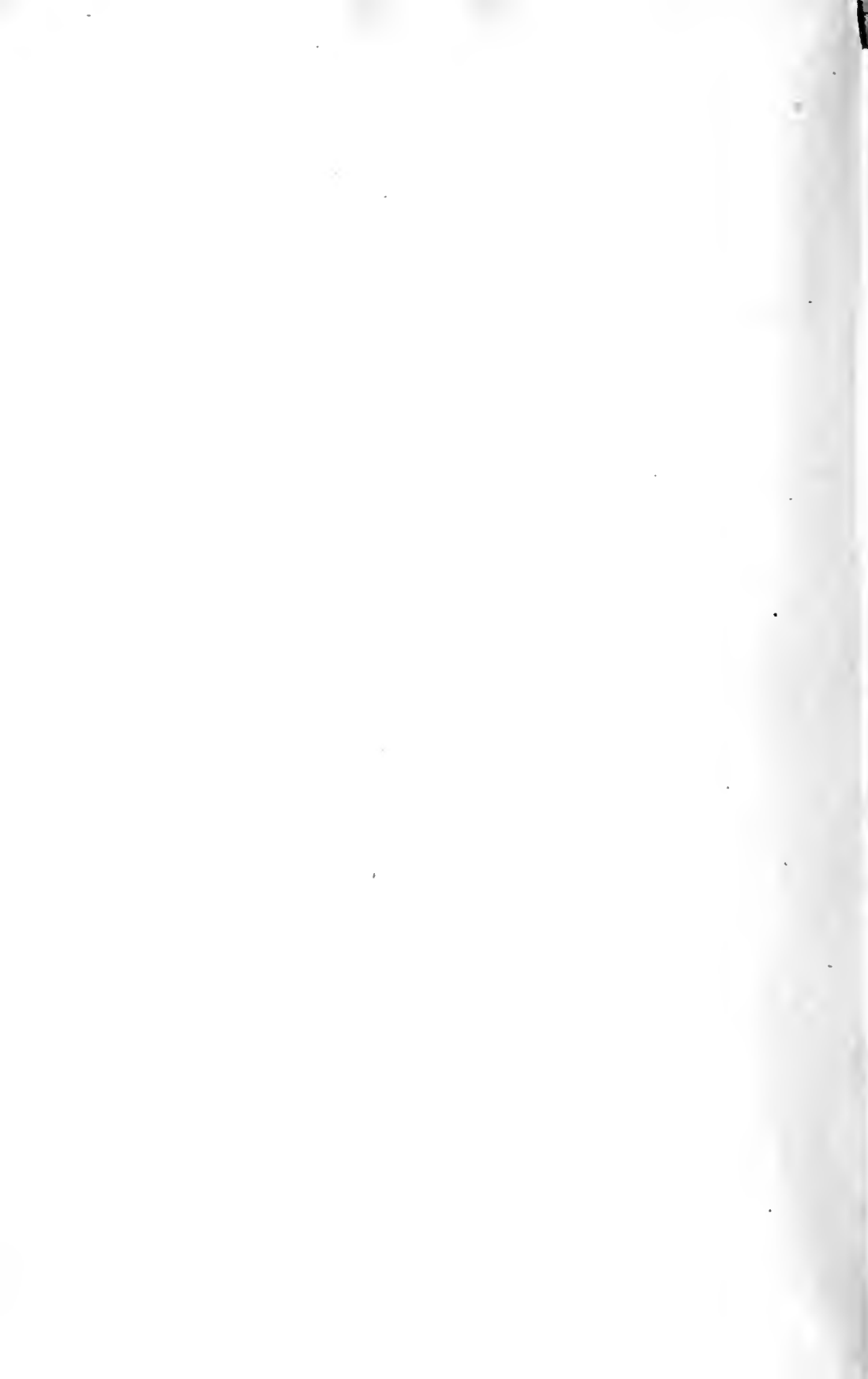
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# SESSIONAL PAPERS

VOLUME 15

SECOND SESSION OF THE ELEVENTH PARLIAMENT

OF THE

DOMINION OF CANADA

SESSION 1910

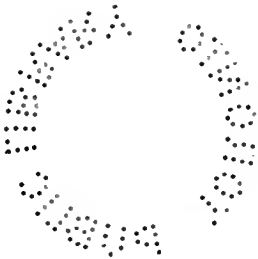


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(This volume is bound in two parts.)

1. Report of the Auditor General for the year ended 31st March, 1909. Volume I, Parts A, C to J (inclusive) L, M, N; Volume III, Parts V, W, X, Y. Presented 12th November, 1909, by Hon. W. S. Fielding. Volume II, Parts B, K and O to U, (inclusive), presented 12th January, 1910, by Hon. W. S. Fielding.  
*Printed for both distribution and sessional papers.*

### CONTENTS OF VOLUME 2.

2. Public Accounts of Canada, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. W. S. Fielding.  
*Printed for both distribution and sessional papers.*
3. Estimates of the sums required for the services of Canada for the year ending on the 31st March, 1911. Presented 18th November, 1909, by Hon. W. S. Fielding.  
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4. Supplementary Estimates of sums required for the service of Canada, for the fiscal year ending 31st March, 1910. Presented 24th November, 1909, by Hon. W. S. Fielding.  
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5. Further Supplementary Estimates of sums required for the service of Canada, for the fiscal year ending 31st March, 1910. Presented 14th March, 1910, by Hon. W. S. Fielding.  
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- 5a. Supplementary Estimates of sums required for the service of Canada for the fiscal year ending 31st March, 1911. Presented 3rd February, 1910, by Hon. W. S. Fielding.  
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- 5b. Further Supplementary Estimates of the sums required for the service of Canada, for the fiscal year ending 31st March, 1911. Presented 30th April, 1910, by Hon. W. S. Fielding.  
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- 9.** Abstract of Statements of Insurance Companies in Canada, for the year ended 31st December, 1909.  
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- 10.** Report of the Department of Trade and Commerce, for the fiscal year ended 31st March, 1909. Part I.—Canadian Trade. Presented 12th November, 1909, by Hon. W. S. Fielding. . . . .*Printed for both distribution and sessional papers.*
- 10a.** Report of the Department of Trade and Commerce. Part II.—Canadian Trade with France, Germany, United Kingdom and United States. Presented 12th November, 1909, by Hon. W. S. Fielding. . . . .*Printed for both distribution and sessional papers.*
- 10b.** Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part III.—Canadian Trade with foreign countries except France, Germany, United Kingdom and United States. Presented 29th November, 1909, by Sir Wilfrid Laurier. . . . .*Printed for both distribution and sessional papers.*

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- 10d.** Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part V.—Grain Statistics, including the crop year ended 31st August, 1909, and season of navigation ended 10th December, 1909. Presented 18th March, 1910, by Hon. W. S. Fielding. . . . .*Printed for both distribution and sessional papers.*
- 10e.** Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part VI.—Subsidized Steamship Services, with statistics showing steamship traffic to 31st December, 1909, and estimates for fiscal year 1910-1911. Presented 3rd May, 1910, by Sir Wilfrid Laurier. . . . .*Printed for both distribution and sessional papers.*
- 10f.** Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part VII.—Trade of Foreign Countries and Treaties and Conventions. Presented 25th April, 1910, by Sir Wilfrid Laurier.  
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- 10h.** Trade relations with Germany.—No. 2. Presented 2nd March, 1910, by Hon. W. S. Fielding. . . . .*Printed for sessional papers.*
- 10i.** Correspondence respecting negotiations between the United States and the Dominion of Canada relative to trade relations. Presented 27th April, 1910, by Hon. W. S. Fielding.  
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- 15a.** Report of the Dairy and Cold Storage Commissioner, for the year ending 31st March, 1909. . . . .*Printed for both distribution and sessional papers.*

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- 17.** Criminal Statistics for the year ended 30th September, 1909.  
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- 18.** Return of By-Elections (Tenth Parliament) of the House of Commons of Canada, held during the year 1908. Presented 4th February, 1910, by Hon. C. Murphy.  
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- 18a.** Return of By-Elections (Tenth Parliament) of the House of Commons of Canada, held during the year 1909. Presented 2nd March, 1910, by Hon. C. Murphy.  
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- 19c.** Supplementary Report of the International Waterways Commission, 1909. Presented 19th November, 1909, by Hon. W. Pugsley.  
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- 20b.** Railway Statistics of Canada, for the year ended 30th June, 1909. Presented 12th January, 1910, by Hon. G. P. Graham.  
*Printed for both distribution and sessional papers.*
- 20c.** Fourth Report of the Board of Railway Commissioners for Canada, to 31st March, 1908, for the year ending 31st March, 1909. Presented 12th November, 1909, by Hon. G. P. Graham. . . . .*Printed for both distribution and sessional papers.*
- 20d.** Report of the Hudson Bay Railway Surveys. Presented 13th December, 1909, by Hon. G. P. Graham. . . . .*Printed for both distribution and sessional papers.*
- 21.** Report of the Department of Marine and Fisheries (Marine) for 1908. Presented 15th November, 1909, by Hon. L. P. Brodeur.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 12.**

- 21a.** Eighth Report of the Geographic Board of Canada, containing all decisions to June 30, 1909. Presented 25th November, 1909, by Hon. L. P. Brodeur.  
*Printed for both distribution and sessional papers.*
- 21b.** List of Shipping issued by the Department of Marine and Fisheries, being a list of vessels on the registry books of Canada on the 31st December, 1909.  
*Printed for both distribution and sessional papers.*
- 22.** Report of the Department of Marine and Fisheries (Fisheries) for 1909. Presented 12th November, 1909, by Hon. S. A. Fisher.  
*Printed for both distribution and sessional papers.*



**CONTENTS OF VOLUME 13.**

- 22a.** Lobster Fishery. Evidence taken before Commander William Wakeham, M.D., (Officer in charge of the Gulf Fisheries Division) in Quebec and the Maritime Provinces. Two volumes. Presented 11th March, 1910, by Hon. W. Templeman. Also copy of the Report of Commander Wakeham in relation thereto.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 14.**

- 23.** Report of the Harbour Commissioners, &c., to 31st December, 1908. Presented 13th January, 1910, by Hon. R. Lemieux. *Printed for both distribution and sessional papers.*
- 23a.** Report of the Chairman of the Board of Steamboat Inspection, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. S. A. Fisher.  
*Printed for both distribution and sessional papers.*
- 24.** Report of the Postmaster General, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Sir Wilfrid Laurier.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 15.**

- 25.** Report of the Department of the Interior, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. F. Oliver.  
*Printed for both distribution and sessional papers.*
- 25a.** Report of the Chief Astronomer.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 16.**

- 25b.** Annual Report of the Topographical Surveys Branch.  
*Printed for both distribution and sessional papers.*
- 25c.** Report of the High Commissioner for Canada, for the year ended 31st March, 1909. Presented 12th November, 1909, by Hon. F. Oliver.  
*Printed for both distribution and sessional papers.*
- 26.** Summary Report of the Geological Survey Branch of the Department of Mines, for the calendar year 1909.  
*Printed for both distribution and sessional papers.*
- 26a.** Summary Report of the Mines Branch of the Department of Mines.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 17.**

- 27.** Report of the Department of Indian Affairs, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. F. Oliver.  
*Printed for both distribution and sessional papers.*
- 28.** Report of the Royal Northwest Mounted Police, 1909. Presented 12th January, 1910, by Sir Wilfrid Laurier. . . . . *Printed for both distribution and sessional papers.*

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**CONTENTS OF VOLUME 18.**

- 29.** Report of the Secretary of State of Canada for the year ended March 31, 1909. Presented 25th November, 1909, by Hon. C. Murphy.  
*Printed for both distribution and sessional papers.*
- 29a.** Report of the Imperial Conference with representatives of the self-governing Dominions on the Naval and Military Defence of the Empire, 1909. Presented 17th November, 1909, by Sir Frederick Borden. Also with additional papers relating to Australia and New Zealand, presented 10th December, 1909, by Hon. L. P. Brodeur.  
*Printed for both distribution and sessional papers.*
- 29b.** Report of the Department of External Affairs, 1909.  
*Printed for both distribution and sessional papers.*
- 30.** Civil Service List of Canada, 1909. Presented 12th January, 1910, by Hon. C. Murphy.  
*Printed for both distribution and sessional papers.*
- 31.** First Annual Report of the Civil Service Commission of Canada, for the period from September 1st, 1908, to August 31, 1909. Presented 10th December, 1909, by Hon. C. Murphy.  
*Printed for both distribution and sessional papers.*
- 32.** Annual Report of the Department of Public Printing and Stationery, for the fiscal year ended 31st March, 1909. Presented 18th April, 1910, by Hon. C. Murphy.  
*Printed for both distribution and sessional papers.*

**CONTENTS OF VOLUME 19.**

- 33.** Report of the Joint Librarians of Parliament for the year 1908-9. Presented 11th November, 1909, by the Hon. the Speaker. . . . .*Printed for sessional papers.*
- 34.** Report of the Minister of Justice as to Penitentiaries of Canada, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. A. B. Aylesworth.  
*Printed for both distribution and sessional papers.*
- 35.** Report of the Militia Council, for the fiscal year ended 31st March, 1909. Presented 1st December, 1909, by Sir Frederick Borden.  
*Printed for both distribution and sessional papers.*
- 35a.** Interim Report of the Militia Council for the Dominion of Canada on the Training of the Militia during the season of 1909. Presented 25th April, 1910, by Sir Frederick Borden. . . . .*Printed for distribution.*
- 36.** Report of the Department of Labour, for the fiscal year ended 31st March, 1909. Presented 12th March, 1909, by Hon. L. M. King.  
*Printed for both distribution and sessional papers.*
- 36a.** Report of the Deputy Minister of Labour on industrial conditions in the Coal Fields of Nova Scotia. Presented 25th November, 1909, by Hon. L. M. King.  
*Printed for both distribution and sessional papers.*
- 37.** Fifth Report of the Commissioners of the Transcontinental Railway, for the year ended 31st March, 1909. Presented 12th November, 1909, by Hon. G. P. Graham.  
*Printed for both distribution and sessional papers.*
- 38.** Statement of Governor General's Warrants issued since the last session of parliament on account of the fiscal year 1909-10. Presented 15th November, 1909, by Hon. W. S. Fielding. . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 39.** Statement in pursuance of section 17 of the Civil Service Insurance Act, for the year ended 31st March, 1909. Presented 16th November, 1909, by Hon. W. S. Fielding. *Not printed.*
- 40.** Statement of expenditure on account of miscellaneous unforeseen expenses, from the 1st April, 1909, to the 10th November, 1909, in accordance with the Appropriation Act of 1909. Presented 16th November, 1909, by Hon. W. S. Fielding. . . . .*Not printed.*
- 41.** Statement of superannuation and retiring allowances in the Civil Service during the year ended 31st December, 1909, showing name, rank, salary, service, allowance and cause of retirement of each person superannuated or retired, also whether vacancy filled by promotion or by new appointment, and salary of any new appointee. Presented 16th November, 1909, by Hon. W. S. Fielding. . . . .*Not printed.*
- 42.** Return of constables employed on the Transcontinental Railway, as required under the provisions of section 6, chapter 92, of the Revised Statutes of Canada. Presented 19th November, by Hon. A. B. Aylesworth. . . . .*Not printed.*
- 42a.** Return to an order of the House of Commons, dated 16th November, 1909, for a copy of all reports, letters, communications and documents touching or relating to the resignation of Hugh D. Lumsden from his position as Chief Engineer of the National Transcontinental Railway, including a copy of all letters, communications or reports of the said Hugh D. Lumsden to the Prime Minister, touching or relating to his resignation, or to the affairs of the National Transcontinental Railway. Presented 23rd November, 1909.—*Mr. Borden. . . . .Printed for both distribution and sessional papers.*
- 42b.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence had between the Minister of Railways and the Transcontinental Railway Commission relating to the sub-letting of contracts for the construction of the Transcontinental Railway in New Brunswick; and the failure of sub-contractors to make payment for supplies and material furnished by farmers, merchants and others for use in said work. Presented 13th December, 1909.—*Mr. Crocket. . . . .Not printed.*
- 42c.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence connected with and relating to the letter of the Auditor General to the Secretary of the National Transcontinental Railway Commission of the 18th of August, 1909, in which the Auditor General points out that 64,192 cubic yards of excavation, classified at an average price of 83 66 cents, were subsequently reclassified at \$1.10½ per cubic yard, thereby increasing the cost by the sum of \$17,453.80, and asking for an explanation. Presented 13th December, 1909.—*Mr. Lennox. . . . .Not printed.*
- 42d.** Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all certificates, recommendations, letters, memoranda and documents in connection with the promotion of Mr. McIntosh on the 16th of November, 1908, from the position of Division Engineer, Division No. 6, District F, to the position of Assistant District Engineer, District F, and the increase of his salary from \$200 to \$275 per month; also of all complaints against the professional conduct or efficiency of Mr. McIntosh made to the Transcontinental Railway or the Railway Department before the date of promotion. Presented 24th January, 1910.—*Mr. Lennox. . . . .Not printed.*
- 42e.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence between the following legal firms: Rothwell & Johnson, Rothwell, Johnson & Bergeman, and Rothwell, Johnson & Stubbs, on the one side, and the Government or the Transcontinental Railway Commissioners, on the other side, as to the instructions to the solicitors for legal services rendered in passing titles of property

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**CONTENTS OF VOLUME 19—Continued.**

acquired by the Government, and in respect to the bill of cost and charges of the said several firms; and all papers, documents, letters, telegrams and correspondence having any reference to the items of charges of said firms appearing on page W-370 of the Auditor General's Report of 1909, amounting in the whole to \$1,376.60. Presented 24th January, 1910.—*Mr. Meighen*. . . . .*Not printed.*

- 42f.** Return to an order of the House of Commons, dated 17th December, 1909: 1. Showing the names and addresses of the engineers who surveyed and located the line of the Eastern Division of the Transcontinental Railway, and the part of the railway covered by the work of each engineer. 2. The name and address of the engineer who prepared the estimates of quantities and prices of the section or portion of the line covered by each contract. 3. The names of the engineers acting upon behalf of the Railway Department, or Railway Commission, and the Grand Trunk Pacific Railway Company, in determining upon the form and wording of the specifications, as provided for by the seventh section of the agreement between the government and the company. 4. The names of such of the engineers acting in any of the capacities aforesaid, as subsequently acted in connection with construction, when and for how long, in what capacity, where their services have been dispensed with, and for what cause. 5. The names and addresses of all the engineers in the service of the Railway Commission, or Railway Department, on Districts B and F of the said Eastern Division, since the commencement of the construction of the railway, the capacity in which each was employed, the salary in each case, the promotions, increases of salary, retirements and dismissals which have taken place, the cause for promotion, dismissal or retirement in each case, and a copy of all complaints lodged with the commissioners or their chief engineer or the department, against any of these engineers. 6. The names of the engineers now in charge of or engaged upon District B and F, and the official position and salary of each. Presented 3rd February, 1910.—*Mr. Lennor*. . . . .*Not printed.*
- 42g.** Interim Report of the Commissioners of the Transcontinental Railway, being for the nine months ended 31st December, 1909, setting forth the receipts and expenditure in connection with the Eastern Division of the National Transcontinental Railway, and such other matters in relation to the said railway as appear to be of public interest. Presented 4th February, 1910, by Hon. G. P. Graham. . . . .*Not printed.*
- 42h.** Return to an order of the House of Commons, dated 7th February, 1910, showing all written objection to classification upon the Transcontinental Railway made since July 28th, 1908, and in reference to overbreak or other over expenditure since 2nd October, 1908. Presented 17th February, 1910.—*Mr. Lennor*. . . . .*Not printed.*
- 42i.** Return to an order of the House of Commons, dated 24th January, 1910, showing: (a) The names of the contractors for the construction of the National Transcontinental Railway and the number, mileage and location of the contract; (b) the estimated expenditure under each contract at the time the contract was let, based upon the engineer's estimate of quantities, at dates of the accepted tender; (c) the estimated increase or decrease in expenditure in each case occasioned by change in location, specification, construction, material, grade or other change subsequent to the letting of the contract; (d) the amount returned and claimed on progress estimates under each contract to date, the amount actually paid under each contract, and the estimated amount yet required to complete the work in each case; (e) the engineer's estimated quantity of solid rock, loose rock and common excavation in the section of line covered by each contract, the estimated cost under these headings, based upon the rates of the accepted tender, the actual expenditure under these headings to date, as shown by progress estimates, the amounts actually paid to date under these headings, and the

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**CONTENTS OF VOLUME 19—Continued.**

estimated quantities of work yet to be done, and the estimated sums yet to be paid under these headings in respect of each contract. Also as to all contracts other than the twenty-one covered by the Return brought down on the 26th of April, 1909, No. 46h: a copy of (a) engineer's itemized estimate of quantities as to each contract of each class of work and material, as set out in the schedules and itemized, and total estimated expenditure based upon rates of accepted tender, and (d) a copy of all tenders received; (c) itemized quantities of work and material under the various headings actually done or furnished to date, and itemized, and total expenditure therefor; itemized statement of estimated quantities of work yet to be done and material, &c., yet to be furnished and itemized, and total estimated cost of the same based on contract prices. Presented 17th February, 1910.—*Mr. Lennor.*

*Not printed.*

- 42j.** Return to an address of the House of Commons, dated 14th February, 1910, for a copy of all correspondence, submissions, references, reports, returns and orders in council, in reference to the adjustment of the disputed item of 581 cubic yards of excavation, claimed at 10 instead of \$2.50 a cubic yard, referred to in a letter of the Auditor General to the Secretary of the Transcontinental Commission, dated the 18th August, 1909. Presented 24th February, 1910.—*Mr. Lennor.* . . . . .*Not printed.*
- 43.** Report of Robert M. Coulter, Deputy Postmaster General, on his mission to Australia and New Zealand to discuss with the governments of those countries the possibility of taking steps that would lead to the inauguration of a steamship service between England, Australia and New Zealand, via Canada, on the Atlantic and Pacific oceans. Presented 22nd November, 1909, by Sir Wilfrid Laurier. . . . .*Printed for sessional papers.*
- 44.** Return to an order of the House of Commons, dated 16th November, 1909, for a copy of all correspondence, documents and papers of every description not already brought down touching the recent treaty with the French Republic, or any modification therein. Presented 24th November, 1909.—*Mr. Borden.* . . . . .*Not printed.*
- 45.** Minutes of proceedings of the Board of Internal Economy of the House of Commons for the past year, pursuant to Rule of the House No. 9. Presented 24th November, 1909, by the Hon. The Speaker. . . . .*Not printed.*
- 46.** Detailed statement of all bonds or securities registered in the Department of the Secretary of State of Canada, since last return (2nd February, 1909), submitted to the parliament of Canada under section 32 of chapter 19, of the Revised Statutes of Canada, 1906. Presented 25th November, 1909, by Hon. C. Murphy. . . . .*Not printed.*
- 47.** Return under chapter 125 (R.S.C), 1906, intituled: 'An Act respecting Trade Unions,' submitted to parliament in accordance with section 33 of the said Act. Presented 25th November, 1909, by Hon. C. Murphy. . . . .*Not printed.*
- 48.** Return of orders in council passed between the 1st of December, 1908 and the 31st October, 1909, in accordance with the provisions of section 5 of the Dominion Land Survey Act, chapter 21, 7-8 Edward VII. Presented 29th November, 1909, by Hon. F. Oliver. . . . .*Not printed.*
- 49.** Return of orders in council which have been published in the *Canada Gazette* and in the *British Columbia Gazette*, between 1st December, 1908, and 31st October, 1909, in accordance with provisions of subsection (d) of section 38 of the regulations for the survey, administration, disposal and management of Dominion lands within the 40-mile railway belt in the province of British Columbia. Presented 29th November, 1909, by Hon. F. Oliver. . . . .*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

50. Return of orders in council passed between the 1st December, 1908, and the 31st October, 1909, in accordance with the provisions of the Forest Reserve Act, sections 7 and 13 of chapter 56, Revised Statutes of Canada. Presented 29th November, 1909, by Hon. F. Oliver. . . . . *Not printed.*
51. Return of orders in council passed between the 1st December, 1908, and the 31st October, 1909, in accordance with the provisions of the Rocky Mountain Park Act, section 5 of chapter 60, Revised Statutes of Canada. Presented 29th November, 1909, by Hon. F. Oliver. . . . . *Not printed.*
52. Return of orders in Council which have been published in the *Canada Gazette*, between 1st December, 1908, and 31st October, 1909, in accordance with the provisions of section 77 of the Dominion Lands Act, chapter 20 of the Statutes of Canada, 1908. Presented 29th November, 1909, by Hon. F. Oliver. . . . . *Not printed.*
53. Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all correspondence and papers respecting the application by the United States immigration service to the Minister of the Interior, for the deportation of one Mrs. Goby, an alleged immigrant, to the United States of America from Canada, entering at the port of Sault Ste. Marie, Michigan, together with a copy of all orders, decisions, reports and returns regarding any action taken thereupon by the Department of the Interior. Presented 1st December, 1909.—*Mr. Boyce*. . . . . *Not printed.*
54. General orders issued to the Militia between the 1st February, 1909, and the 1st November, 1909, inclusive. Presented 1st December, 1909, by Sir Frederick Borden. . . . . *Not printed.*
55. Report of the Ottawa Improvement Commission for the fiscal year ended 31st March, 1909. Presented 3rd December, 1909, by Hon. W. S. Fielding. . . . . *Printed for sessional papers.*
56. Certified copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 12th May, 1909, on the subject of a despatch from the Right Honourable the Principal Secretary for the Colonies, transmitting an invitation from the Honorary Secretary of the 12th International Congress on Alcoholism to the Government of Canada, to appoint delegates to attend the congress in question. Presented 6th December, 1909, by Sir Wilfrid Laurier. . . . . *Not printed.*
57. Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all memorials, reports, correspondence and documents in the possession of the government not already brought down, relating to a survey of a route for a tunnel under the Straits of Northumberland between the province of Prince Edward Island and the mainland of Canada, and also relating to the construction of such tunnel. Presented 6th December, 1909.—*Mr. Warburton*. . . . . *Not printed.*
58. Return (in so far as the Department of the Interior is concerned) of copies of all orders in council, plans, papers, and correspondence which are required to be presented to the House of Commons, under a resolution passed on 20th February, 1882, since the date of the last return, under such resolution. Presented 7th December, 1909, by Hon. F. Oliver. . . . . *Not printed.*
- 58a. Return of lands sold by the Canadian Pacific Railway during the year ended on the 31st October, 1909. Presented 18th January, 1910, by Hon. F. Oliver. . . . . *Not printed.*
59. Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all orders in council at present in force with reference to immigration; also a copy of all regulations in force at the present time in connection with immigration in Canada. Presented 9th December, 1909.—*Mr. Wilson (Lennor)*. . . . . *Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 60.** Return to an order of the House of Commons, dated 22nd November, 1909, showing:—  
 1. The application made to the Railway Board for protection of railway crossings under the provisions of chapter 32 of the Statutes of 1909, an Act to amend the Railway Act, and (a) the cases in which these applications have been granted, (b) in which they have been refused, when refused, and the reason for refusal. 2. The names of the persons in each case making the application. 3. The cases in which the board of its own motion made an order for the protection of crossing under said act. 4. The appropriation made by the board out of the Railway Grade Crossing Fund under said act, and the crossing in respect of which such appropriations were made. 5. The character or description of the crossing in question, and the character, description and cost in each case of the construction work of protection ordered or directed by the board. 6. The amount in each case ordered or directed by the board to be paid out of the said fund and by the railway company and municipality or other party to the proceedings. 7. The cases in which the work ordered to be done (a) has been completed, (b) in which it is under construction, (c) the cases in which the municipality has submitted to or complied with the order of the board, and (d) cases in which the municipality has refused to comply. Presented 14th December, 1909.—*Mr. Lennor.*  
*Not printed.*
- 61.** Return to an order of the House of Commons, dated 24th November, 1909, showing what Indian lands within the territories now covered by each of the provinces of Manitoba, Saskatchewan and Alberta, have been sold yearly since 30th June, 1900; such information to be detailed as follows: the name of each reserve, the area sold therein yearly, the average prices realized, and the cash paid to the Indians concerned at the time of sale, under the terms of surrender. Presented 15th December, 1909.—*Mr. McGrath.*  
*Not printed.*
- 62.** Return to an order of the House of Commons, dated 22nd November, 1909, showing the areas sold or leased as oil lands in the Northwest, giving the amount sold or leased, the date when, and the parties to whom sold or leased, and if leased, the various assignments, if any, made thereof, and the dates of the same. Presented 15th December, 1909.—*Mr. Foster.* . . . . .*Not printed.*
- 63.** Return to an order of the House of Commons, dated 16th November, 1909, showing: Copy of the contract for the dredging of the Napanee river during the summer of 1909; name of the contractor who had the contract; names of the engineers in charge of the work and the inspector; the depth and width of the channel after dredging; the length of time taken to complete the work; the total amount of money expended on the work; whether the work was done by day work or by the yard; and the prices paid by day or by yard. Presented 15th December, 1909.—*Mr. Wilson (Lennor).*  
*Not printed.*
- 64.** Return made to parliament in accordance with chapter 47, section 4, Revised Statutes, 1906, containing copy of the orders in council for the issue of licenses to United States fishing vessels to enable them to buy bait, ice, lines, &c. during the year 1910. Presented 16th December, 1909, by Hon. L. P. Brodeur. . . . .*Not printed.*
- 65.** Return, in pursuance of section 16 of the Government Annuities Act, 1908, containing statement of the business done during the fiscal year ending March 31st, 1909, together with a copy of the regulations made under section 13 of the act. Presented 17th December, 1909, by Hon. W. S. Fielding. . . . .*Printed for sessional papers.*
- 66.** Report of the Commissioner, Dominion Police Force, for the year 1909. Presented 12th January, 1910, by Hon. A. B. Aylesworth. . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 67.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all reports and correspondence in connection with section 29, township 9, range 22, west of the 4th meridian, as well as applications for railway right of way and station grounds within such land. Presented 12th January, 1910.—*Mr. McGrath..Not printed.*
- 68.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all papers, reports, correspondence, &c., between the Department of the Interior and its officers and agencies and any other persons, relative to the s.w.  $\frac{1}{4}$  section 24-38-10 w. 3rd m., and the respective claims of Allan R. Mudie and Thos. G. Warwick. Presented 12th January, 1910.—*Mr. Lake.. . . . .Not printed.*
- 69.** Return to an order of the House of Commons, dated 15th December, 1909, showing the names of the two hundred and twenty-one members of the House of Commons, as provided for in 6-7 Edward VII., Dominion Statutes, 1907, chapter 41, section 1, excepting only such seat or seats as have fallen vacant. Presented 12th January, 1910.—*Mr. White (Renfrew).. . . . .Not printed.*
- 70.** Return to an order of the House of Commons, dated 24th November, 1909, showing the total number of incubators and brooders, respectively, imported into Canada from the United States during the fiscal year ending March 31st, 1909, and the total cost of each. Presented 13th January, 1910.—*Mr. White (Renfrew).. . . . .Not printed.*
- 71.** Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all letters, telegrams, applications, contracts and correspondence with regard to the taking of spawn for the fish hatchery at Snake Island, Winnipegosis, for the years 1907, 1908 and 1909. Presented 13th January, 1910.—*Mr. Campbell.. . . .Not printed.*
- 72.** Return to an order of the House of Commons, dated 15th December, 1909, showing a list of all exports, technical advisers, and special officers generally, engaged by the government in connection with the naval defence programme and its execution, giving names, special qualifications, duration of engagement and rate of remuneration, as well as the total amount expended to date under the above; also amounts expended to date for articles, books, instruments and objects of all kinds in connection with said naval defence programme. Presented 13th January, 1910.—*Mr. Monk.*  
*Printed for sessional papers.*
- 73.** Return to an order of the House of Commons, dated 29th November, 1909, showing the number of lighthouses in British Columbia, the salaries of the lightkeepers at the end of the financial year 1907-1908; what the salaries are to-day; why some salaries have been reduced and when such reduction took place. Presented 13th January, 1910.—*Mr. Smith (Nanaimo).. . . . .Not printed.*
- 74.** Return to an address of the House of Commons, dated 18th November, 1909, for a copy of all orders in council, correspondence, documents and papers of every description relating to the proposed sale or disposal of any part of the Peigan Indian Reserve in the province of Alberta, including any advertisement of such sale and record of the proceedings, whether by vote or otherwise, under which any of the Indians on said reserve purported to give their consent thereto. Also a return showing the actual number of Indians on said reserve entitled to vote or elect in respect of such proposed sale, and all other information in the possession of the department or its officials relating to or in any way referring to the proceedings in connection with such proposed sale. Presented 13th January, 1910.—*Mr. Herron.. . . . .Not printed.*



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**CONTENTS OF VOLUME 19—Continued.**

- 75.** Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all papers, reports, correspondence, &c., between the Department of the Interior, and its officers and agencies, and any other person, relative to the s.w.  $\frac{1}{4}$  section 16-30-9, w. 3rd m., and the respective claims thereto of Thomas Paterson and J. E. Sibbald. Presented 13th January, 1910.—*Mr. Lake*... ..*Not printed.*
- 76.** Return to an order of the House of Commons, dated 24th November, 1909, showing approximately the amount of revenue collected by the government between the 1st January, 1908, and the 1st November, 1909, in the province of Alberta and Saskatchewan, respectively, on account of payments for coal lands, coal royalties, bonuses and rental on timber lands, timber dues, hay lands, grazing lands, irrigation areas, school lands, minerals, water powers, stone quarrying lands, Indian lands, or on account of any natural resources within each of the above provinces. Presented 13th January, 1910—*Mr. McCarthy*... ..*Not printed.*
- 77.** Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all documents and papers relating to the western shipment of grain. Presented 13th January, 1910.—*Mr. Taylor (Leeds)*... ..*Not printed.*
- 78.** Return to an order of the House of Commons, dated 24th November, 1909, for a copy of all letters, correspondence and complaints, or other papers, from Indians or others regarding the manner in which the St. Peter's Indians have been treated relating to lands allotted to them by the government in consideration of the surrender of St. Peter's Reserve. Presented 13th January, 1910.—*Mr. Bradbury*... ..*Not printed.*
- 78a.** Return to an order of the House of Commons, dated 13th December, 1909, for a copy of all instructions to J. O. Lewis, Indian Agent at Selkirk, regarding the delivery of patents to Indians entitled to same, in connection with the surrender of St. Peter's Reserve. Presented 13th January, 1910.—*Mr. Bradbury*... ..*Not printed.*
- 78b.** Return to an order of the House of Commons, dated 6th December, 1909, showing all moneys paid by the government in connection with the surrender of St. Peter's Reserve, to whom paid, and for what; also all moneys paid in connection with the moving of the Indians to the new reserve on Lake Winnipeg, to whom paid, and for what. Presented 13th January, 1910.—*Mr. Bradbury*... ..*Not printed.*
- 78c.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all instructions sent to the Indian Agent at Selkirk, in connection with St. Peter's Indians pledging or disposing of their holdings, secured through the surrender of their reserve; a statement showing all those entitled to receive patents for lands in connection with the surrender of the reserve, the applications made by those so entitled for their patents, and receipts signed for the patents by those so entitled on delivery of the patent. Presented 13th January, 1910.—*Mr. Bradbury*... ..*Not printed.*
- 78d.** Copy of papers relating to St. Peter's Indian Reserve, comprising letters of instructions and commission to Mr. H. M. Howell, Report of H. M. Howell, and advertisement in connection with auction sale of lands. Presented 27th January, 1910, by Hon. F. Oliver... ..*Not printed.*
- 78e.** Return to an order of the House of Commons, dated 17th January, 1910, for a copy of all accounts of George Tracy, of Selkirk, against Indians of St. Peter's Reserve, Manitoba, now on file in the Department of Indian Affairs here, and of all correspondence in the department in relation thereto. Presented 31st January, 1910.—*Mr. Bradbury*... ..*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 78f.** Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all papers and instructions given to A. S. Williams, Law Clerk of the Department of Indian Affairs, and to S. Swinford, Inspector of Indians, Winnipeg, in connection with their work among the St. Peter's Indians in Manitoba; also a copy of the report of these gentlemen in connection with the work they have been engaged in during the last few weeks among the St. Peter's Indians. Presented 4th April, 1910.—*Mr. Bradbury.*  
*Not printed.*
- 79.** Return to an order of the Senate, dated 26th November, 1909, for a copy of the several complaints which in 1908 and 1909 have been made by different parties to the Minister of the Interior or to the Superintendent of Immigration of the manner in which immigrants are treated at Quebec. Presented 13th January, 1910.—*Hon. Mr. Landry.*  
*Not printed.*
- 80.** Return to an order of the Senate, dated 2nd December, 1909, for a copy of all accounts filed during the fiscal year 1907-8 in the Department of the Interior by Sosthène Morisset, one of the clerks of the Immigration office at Quebec. Presented 13th January, 1910.—*Hon. Mr. Landry.* . . . . .*Not printed.*
- 80a.** Return to an order of the Senate, dated 3rd December, 1909, for a copy (1) of the medical certificate given by Doctors Pagé and Nadeau to justify the order for the sending back of the immigrant Otta Nittinen, in November, 1908; (2) of the correspondence on this subject exchanged between the agent of the Canadian Pacific Railway, Mr. Jules Hone, and Messrs. Lavoie and Stein of the Immigration Office at Quebec, and the Superintendent General of Immigration at Ottawa, Mr. W. D. Scott, in November and December, 1908. Presented 13th January, 1910.—*Hon. Mr. Landry.*  
*Not printed.*
- 80b.** Return to an order of the Senate, dated 3rd December, 1909, for a copy of the attendance and pay-lists of the employees in the Immigration Office at Quebec, for the first four months of the present year. Presented 13th January, 1910.—*Hon. Mr. Landry.*  
*Not printed.*
- 80c.** Return to an order of the Senate, dated 2nd December, 1909, for the Report of Detentions and Deportations at the port of Quebec for the month of November, 1908. Presented 13th January, 1910.—*Hon. Mr. Landry.* . . . . .*Not printed.*
- 80d.** Return to an address of the Senate, dated 25th January, 1910, for a copy of the attendance and pay-lists of the employees of the Immigration Office at Quebec, for the months of January, February, March and April of 1909. Presented 10th February, 1910.—*Hon. Mr. Landry.* . . . . .*Not printed.*
- 80e.** Return to an order of the Senate, dated 12th January, 1910, for a copy of the report made in 1906 to the Department of the Interior by Mr. Blair, upon the inquiry held by him at Quebec, at the Immigration Office, on the subject of certain complaints concerning the administration of the said office. Presented 22nd February, 1910.—*Hon. Mr. Landry.* . . . . .*Not printed.*
- 80f.** Return to an order of the House of Commons, dated 13th December, 1909, for a copy of the correspondence exchanged since the 1st of January, 1908, between the medical examiners of immigrants and the Superintendent of Immigration, respecting the inspection of immigrants. Presented 23rd March, 1910.—*Mr. Paquet.* . . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 80g.** Return to an order of the Senate, dated 10th March, 1910, for the production of all complaints made to the Department of the Interior against the present Immigration Agent at Quebec, and of all the correspondence exchanged on this subject between the different parties in question and the department or any of its officers. Presented 6th April, 1910.—*Hon. Mr. Landry*. . . . . *Not printed.*
- 80h.** Return to an order of the Senate, dated 2nd March, 1910, calling for the production of all correspondence between the present Immigration Agent at Quebec and his superior in the Department of the Interior, on the subject of his retirement, dismissal or promotion of officers under his control, or of the increase or decrease of their salaries or remuneration. Presented 6th April, 1910.—*Hon. Mr. Landry*. . . . . *Not printed.*
- 80i.** Return to an order of the Senate, dated 1st February, 1910, for a copy of the accounts sent by the restaurant keeper, Jacques Dery, to the Immigration Department, for meals furnished the employees of the Immigration Office at Quebec, from 1st January, 1906, until 1st January, 1910, specifying separately for each employee, the date of each meal and the sum asked, and also a copy of all the accounts sent, from time to time, by the same restaurant keeper during the same period, for meals given and provisions furnished in connection with the Immigration Office at Quebec. Presented 6th April, 1910.—*Hon. Mr. Landry*. . . . . *Not printed.*
- 80j.** Return to an order of the Senate, dated 10th March, 1910, for a copy of all correspondence exchanged between the Immigration Department and Doctor Jos. P. Lavoie, Immigration Agent at Quebec, since the appointment of the latter, with regard to the following subjects, to wit: The expense of equipping his office; the placing of the telephone, the cost and the use of that instrument; the installing of electric fans in the immigrants' eating room, and in the agent's dining room; the changes to be made in the personnel of the Quebec office; the appointment of new employees; and every subject concerning the internal administration of his office. Presented 13th April, 1910.—*Hon. Mr. Landry*. . . . . *Not printed.*
- 80k.** Return to an order of the Senate, dated 7th April, 1910, for the production of the requests or of the complaints made by the navigation companies for the past five years, on the subject of the insufficiency of the means of accommodation put at the disposal of the authorities of Grosse Isle for the benefit of the immigrants, obliged by the regulations to remain there. Presented 2nd May, 1910.—*Hon. Mr. Landry*. . . *Not printed.*
- 80l.** Return to an order of the Senate, dated 26th April, 1910, calling for the production of a copy of the attendance list of the employees of the Immigration Office at Quebec for the month of October, 1908. Presented 4th May, 1910.—*Hon. Mr. Landry*. *Not printed.*
- 80m.** Return to an order of the Senate, dated 7th April, 1910, calling for the production of a copy of the attendance lists of the employees of the Immigration Office at Quebec, from the 1st April, 1909, to this day, and also for a copy of the pay-lists of the same employees during the same period. Presented 4th May, 1910.—*Hon. Mr. Landry*.  
*Not printed.*
- 81.** Return to an order of the House of Commons, dated 16th November, 1909, showing in relation to each dog-fish reduction plant or establishment for the reduction of dog-fish erected by or for the government or maintained in whole or in part by the government, (a) the cost of construction, (b) the cost of maintenance for each year, (c) the location, (d) the quantity of dog-fish treated thereat in each year, and (e) the amount realized from the sale of or the disposal in each year. Presented 17th January, 1910.—*Mr. Borden*.  
*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 82.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, reports, documents and papers touching the matter of the salmon fishery of Salmon River, Digby county, N.S., and the fishways or passes in said river. Presented 17th January, 1910.—*Mr. Jameson*. . . . .*Not printed.*
- 83.** Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all reports, correspondence and other papers relating to the condition and maintenance of the buoy on the Old Proprietor Ledge in the Bay of Fundy since January 1st, 1908; also of all reports, correspondence and other papers relating to the establishment, equipment, maintenance and operation of the life boat and life saving station at Seal Cove, in the Bay of Fundy; also copy of all instructions issued to Captain Lugar in connection with the inquiry into the wreck of the ss. *Hestia*, and of the findings and report on said inquiry. Presented 17th January, 1910.—*Mr. Daniel*. . . . .*Not printed.*
- 83a.** Supplementary Return to No. 83. Presented 14th February, 1910. . . . .*Not printed.*
- 84.** Return to an order of the House of Commons, dated 15th December, 1909, showing: 1. The present indebtedness to the Dominion government of the Montreal Turnpike Trust (*a*) on capital account, (*b*) for arrears of interest. 2. The amount collected at each toll gate belonging to the said turnpike trust during the year ending 31st December, 1908, and for the first six months of the year 1909. 3. The names of all parties who have commuted their tolls during each of the two above mentioned periods and the amount of the commutation money paid to the trust in each case. 4. The amount expended on each section or road division under the control of said trust, during the year ending 31st December 1908, and the contracts given out during the said year, with the name of the contractor and the date and amount of money involved in each case; and a statement in each case also as to whether the contract was awarded after tender called through newspapers. 5. The amount paid out during the said two first above-mentioned periods at each toll gate for salaries of day and night guardians and any other expenditures at each of the toll gates maintained. 6. The names of all parties holding passes for free use of the roads under control of said trust during the period above mentioned, with a statement, in each case, of the reason why the pass was so granted. 7. The expenses of the said trust during each of the two periods above mentioned for rent, salaries of the office, inside or outside service, giving name and remuneration of each official and amounts paid to any civil engineer employed by the trust. 8. The actual present indebtedness in detail of said trust outside of its bonds due to the government of Canada. 9. The amounts collected by said trust during the above-mentioned periods from municipalities under special agreements made as to their share pro rata of the bonded indebtedness of the turnpike trust. 10. The names of all members of the trust elected to represent the bondholders, with date of election in each case, during said two periods. 11. The amounts paid by the trust to any of its members or officials during said two periods, whether as travelling or personal expenses, or indemnity for attendance or for any other reason whatever. 12. The name of any auditor who has acted during said two periods, and the amount paid such auditor. 13. An exact statement of any amounts paid by the trust for purchase or lease of any property outside of the city of Montreal and in defraying the travelling or displacement or maintenance expenses of the trustees or their officials generally. Presented 17th January, 1910.—*Mr. Monk*. . . . .*Not printed.*
- 85.** Return to an address of the House of Commons, dated 29th November, 1909, for a copy of all orders in council relating to the North Atlantic Trading Company, and all correspondence between the North Atlantic Trading Company and the government, or any member or official thereof, since November 1, 1906, and up to 20th November, 1909. Presented 20th January, 1910.—*Mr. Wilson (Lennox)*. . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 85a.** Return to an order of the House of Commons, dated 15th December, 1909, for a copy of petition of right of pleas offered in defence in the case of the suit of the North Atlantic Trading Company vs. the King, in the Exchequer Court, and of all correspondence as well as reports and petitions which led up to the government granting a fiat to the suppliant; and a copy of all letters having reference to the said claim now sued upon from the time of the final payment to the said North Atlantic Company. Presented 20th January, 1910.—*Mr. Monk*.. . . .*Not printed.*
- 86.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, documents, and reports since the 1st January, 1908, between our immigration agents in Belgium and the Minister of the Interior. Presented 21st January, 1910.—*Mr. Paquet*.. . . .*Not printed.*
- 86a.** Return to an order of the House of Commons, dated 18th November, 1909, giving the names and addresses of all immigration agents at the present time employed by the government in Great Britain, the continent of Europe, and the United States, on salary, the amount of salary paid to each, the amount of other perquisites paid to each, if any; the names and addresses of all immigration agents at the present time employed by the government in the above countries on commission, the amount of such commission, the rate of commission per immigrant, the amount of other perquisites paid to each; the names and addresses of all special immigration agents in the above countries appointed during the fiscal years 1908-9 and up to 1st November, 1909, the date of the appointment of each, the address of each at the time of his appointment, the amount of salary, commission, or other perquisites paid to each, and the length of time served by each in respect of such appointment. Presented 4th February, 1910.—*Mr. Wilson (Lennox)*.. . . .*Not printed.*
- 87.** Return to an order of the House of Commons, dated 1st December, 1909, showing all casualties and accidents attended with danger or loss of human life, that have occurred in the Marine and Fisheries Department owing to the operation of pintsch and acetylene gas as an illuminant, for each year since 1880, together with a copy of all papers and reports in connection therewith. Presented 20th January, 1910.—*Mr. Foster*.  
*Not printed.*
- 88.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, petitions, and other papers between any person or persons and the government, or any member thereof, or any official thereof, with reference to the dredging of the Napanee river. Presented 20th January, 1910.—*Mr. Wilson (Lennox)*.  
*Not printed.*
- 89.** Return to an order of the House of Commons, dated 13th December, 1909, for a copy of all correspondence had between the Post Office and Public Works Departments, together with all reports and other documents relating to the necessity of providing adequate post office accommodation in the city of Lethbridge. Presented 20th January, 1910.—*Mr. Magrath*.. . . .*Not printed.*
- 89a.** Supplementary Return to No. 89. Presented 18th February, 1910.. . . .*Not printed.*
- 90.** Interim Report of the Dominion Fisheries Commission for the investigation of the waters on Lac du Bonnet fisheries. Presented 20th January, 1910, by Sir Wilfrid Laurier.. . . .*Not printed.*
- 90a.** Interim Report of the Dominion Fisheries Commission for the investigation of the waters of Manitoba and the West. Presented 20th January, 1910, by Sir Wilfrid Laurier.. . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 90b.** Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all letters, telegrams, applications, contracts, lease or leases and correspondence with regard to Lac du Bonnet fishing. Presented 27th January, 1910.—*Mr. Campbell.*  
*Not printed.*
- 90c.** Return to an address of the House of Commons, dated 4th February, 1909, for a copy of all correspondence, orders in council, papers and documents relating to the question of fisheries in the Pembina river, in the province of Manitoba, and of regulations or agreements with the United States government in reference to the rivers running from one country into the other. Presented 14th February, 1910.—*Mr. Sharpe (Lisgar).*  
*Not printed.*
- 91.** Return to an order of the House of Commons, dated 15th December, 1909, for a copy of the pay sheets of the employees on the Lachine canal under the supervision of Denis O'Brien for the months of May, June, July, August, September, October and November. Presented 24th January, 1910.—*Mr. Ferrille.* . . . . .*Not printed.*
- 92.** Return to an order of the House of Commons, dated 24th January, 1910, for a copy of all instructions given during his term of office by the Honourable Speaker Blanchet, to the then sergeant-at-arms, or to other officials in connection with the appointment of sessional messengers. Presented 26th January, 1910.—*Mr. Monk.* . . . . .*Not printed.*
- 93.** Return to an order of the House of Commons, dated 18th November, 1909, showing the number of fatal accidents resulting from the use of explosives in the construction of railways and other public works in Canada, reported to either the Department of Railways and Canals, the Department of Public Works, or the National Transcontinental Railway Commissioners, within the past three years; the nature of investigation, if held, after each accident; and what precautions have been taken to prevent or minimize the number of accidents from the use of explosives on construction work in Canada under control of government officials. Presented 26th January, 1910.—*Mr. Robb.* . . . . .*Printed for sessional papers.*
- 94.** Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all applications, petitions, letters, telegrams, documents, plans, specifications and correspondence with reference to, and in any way concerning the application for subsidy for the building of a dry-dock and ship-building yard by certain persons, or company, at or in the vicinity of the town of Sault Ste-Marie, Ontario. Presented 26th January, 1910.—*Mr. Boyce.* . . . . .*Not printed.*
- 94a.** Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all applications, petitions, letters, telegrams, documents, plans, specifications and correspondence with reference to and in any way concerning the application for subsidy for the building of a dry-dock and ship-building yard by certain persons, or company, at or in the vicinity of the town of Port Arthur, Ontario. Presented 11th March, 1910.—*Mr. Boyce.* . . . . .*Not printed.*
- 95.** Return to an order of the House of Commons, dated 17th December, 1909, showing: 1. A description by sections, townships and ranges, with areas of all lands included in the area controlled by the Southern Alberta Land Company under agreements with the government, and the date of expiry of such agreements. 2. A description by sections, townships and ranges with areas of all lands held under grazing lease or leases or assignment of leases and now controlled by Messrs. Cowdry & Maunsall, or either of them, of lands which lie between the Bow and Belly rivers, bounded on the east by range 12 and on the west by range 19, west of the fourth meridian. Presented 27th January, 1910.—*Mr. McCarthy.* . . . . .*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

- 96.** Return to an order of the House of Commons, dated 17th January, 1910, showing: 1. What amount has been annually expended by the government since the year 1900 in connection with the Atlantic Fisheries of Canada, apart from sums spent in the fishery protection service and for bounty, in the respective provinces of Nova Scotia, New-Brunswick, Prince Edward Island and Quebec. 2. The amount expended in each of the said provinces annually for fishery breeding purposes, dog-fish reduction plants, bait freezers, cold storage and salaries of officials, respectively. 3. What other general purposes in connection with the fisheries expenditures were made in such provinces within said period. Presented 27th January, 1910.—*Mr. Jameson*. . . . .*Not printed.*
- 97.** Regulations of the National Parks of Canada. Presented 28th January, 1910, by Hon. F. Oliver. . . . .*Printed for sessional papers.*
- 98.** Return to an order of the House of Commons, dated 19th January, 1910, showing all tenders called for by the Department of Railways and Canals, or the purchasing agent of the Intercolonial Railway of Ottawa, at any time during the year 1909, for wire fencing; a copy of any tenders received for such fencing, with the names of the tenderers, and the prices quoted by the said parties tendering for the different kinds of fencing; the names of the successful tenderers, and the particular kind of fencing bought, the gauge of wire, number of stands and distances apart of the brackets in uprights; the price per rod, and where the wire was manufactured. Presented 1st February, 1910.—*Mr. Wilcox*. . . . .*Not printed.*
- 98a.** Return (in part) to an order of the House of Commons, dated 1st December, 1909, for a copy of all papers in connection with the alleged securing and sale or distribution of passes on the Intercolonial Railway within the last two years, and also of all papers of every kind in connection with the alleged padding of pay-lists on the Windsor Branch Railway, and the re-sale of mutilated railway ties to the government. Presented 16th February, 1910.—*Mr. Foster*. . . . .*Not printed.*
- 98b.** Return to an order of the House of Commons, dated 24th January, 1910, showing: 1. How many derailments have taken place on the Intercolonial Railway during the year 1909. 2. At what points of the railway each of these derailments took place, and at what dates. 3. The report made in each case, and the cause or causes mentioned in such report. Presented 17th February, 1910.—*Mr. Talbot*. . . . .*Not printed.*
- 98c.** Return to an order of the House of Commons, dated 7th February, 1910, showing: Since the beginning of the autumn train service of 1909 on the Intercolonial Railway, at what time the train leaves Oxford Junction every week day morning for Picton is due to leave Oxford Junction and arrive at Picton; the actual time at which the train departed each day from Oxford Junction, the actual time at which it arrived each day at Picton; the causes of the delay, if any; and what efforts are being made to improve the service in respect of time. Presented 24th February, 1910.—*Mr. Rhodes*. . . . .*Not printed.*
- 98d.** Return to an order of the Senate dated 15th February, 1910, for a statement showing in so many distinct columns: 1. The names of all the employees of the Intercolonial Railway who have been dismissed or who have resigned since the Intercolonial Railway was put under the direction of the Commission of that road. 2. The respective salaries of such employees. 3. The date of their appointment. 4. The date of their dismissal. 5. The number of the division or of the section of the railway where they were employed. 6. The domicile of such employees at the time of their dismissal. Presented 19th April, 1910.—*Hon. Mr. Landry*. . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 98e.** Return to an order of the House of Commons, dated 14th March, 1910, showing: Since the appointment of the Government Railways' Managing Board, how many employees of the Intercolonial Railway have been dismissed at Truro, at Halifax, and at Stellarton, respectively, with their respective names; at what kind of work each was employed; on what dates, respectively, each one was dismissed; how many of them since re-employed; on what dates, respectively, each one was re-employed; how long since such re-employment each one has remained in the service; how many of them are still in the service, with their names and what each one is employed at. Presented 20th April 1910.—*Mr. Rhodes*. . . . . *Not printed.*
- 98f.** Return to an order of the House of Commons, dated 22nd November, 1909, showing the number of passes issued on the Intercolonial Railway from October 1st, 1908, to October 1st, 1909, whether annual, return trip or trip, to whom issued, the authority and upon whose recommendation the passes were issued and reasons for the issue, the several points at which these passes took effect and the destination, and also a copy of the agreement entered into by the various railways of Canada regarding the non-issuing of passes. Presented 20th April, 1910.—*Mr. Stanfield*. . . . . *Not printed.*
- 99.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all letters, communications, petitions and correspondence with and by the government, or any minister, with regard to the appointment of some one to fill the vacancy on the Board of Railway Commissioners, caused by the demise of the late Honourable Thos. Greenway. Presented 1st February, 1910.—*Mr. Campbell*. . . . . *Not printed.*
- 100.** Return to an address of the House of Commons, dated 29th November, 1909, for a copy of all memorials, reports, correspondence and documents in the possession of the government, relating to the reduction of the representation in the House of Commons, of the several provinces of Nova Scotia, New Brunswick and Prince Edward Island, and of all correspondence with the governments of these provinces with regard to the restoration to the said provinces of such representation as they respectively had at the time of their becoming provinces of this Dominion. Presented 1st February, 1910.—*Mr. Warburton*. . . . . *Printed for sessional papers.*
- 101.** Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all declarations, affidavits and solemn declarations made and sent to the Post Office Department, or to the Honourable the Postmaster General, since the first day of September, 1907, up to the fifteenth day of January, 1910, respecting the franking privilege asked for the *Arthabaska Gazette*, with copies of the lists of pretended subscribers to that newspaper with the said declarations, affidavits and solemn declarations; also a copy of the report of Mr. A. Bolduc, Post Office Inspector, respecting the said *Arthabaska Gazette*. Presented 2nd February, 1910.—*Mr. Lavergne*. . . . . *Not printed.*
- 102.** Return to an order of the House of Commons, dated 13th December, 1909, showing a list of the free mail delivery routes which have been established in Canada, including the port of departure and the place of arrival, the length of each, the number of houses on each route, and the number of boxes on each route. Presented 3rd February, 1910.—*Mr. Armstrong*. . . . . *Printed for sessional papers.*
- 102a.** Return to an order of the House of Commons dated 6th December, 1909, for a copy of all papers, letters, telegrams, documents and correspondence with reference to or in any way concerning the installation of free mail delivery service in the city of Sydney, N.S. Presented 17th February, 1910.—*Mr. Maddin*. . . . . *Not printed.*



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**CONTENTS OF VOLUME 19—Continued.**

- 103.** Return to an order of the House of Commons, dated 3rd February, 1910, for a copy of the report of Commander Wm. Wakeham, Special Commissioner and Inspector of Fisheries for the Gulf of St. Lawrence, on the Lobster Industry of the Maritime Provinces and the province of Quebec. Presented 3rd February, 1910, by Sir Wilfrid Laurier. . . . .*See Sessional Paper No. 22a.*
- 104.** Return to an order of the House of Commons, dated 17th January, 1910, for a copy of all correspondence, reports, despatches, documents and other papers relating in any way to the claim for a home-stead, by the members of the family of Angus Sauve, who was in the African campaign, and who died a short time after his arrival in the country. Presented 4th February, 1910.—*Mr. Boyer*. . . . .*Not printed.*
- 104a.** (1909). 1. International Boundary Waters Treaty, signed at Washington, 11th January, 1909. 2. Rider attached by the United States Senate.  
*Printed for both distribution and sessional papers.*
- 105.** Report of a system of uniform and common international regulations for the protection and preservation of the food fishes in international boundary waters of Canada and the United States. Prepared by the International Fisheries Commission pursuant to and under the authority of the Convention of April 14, 1908, between Great Britain and the United States. Presented 4th February, 1910, by Sir Wilfrid Laurier. . . . .*Printed for distribution.*
- 106.** Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all papers, letters, telegrams, documents and correspondence, occurring during the first six months of 1908, in connection with suggested amendments to the Northwest Irrigation Act. Presented 7th February, 1910.—*Mr. Magrath*. . . . .*Not printed.*
- 107.** Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all petitions addressed to His Excellency the Governor General of Canada, or to the government, or any department thereof; also of all letters, correspondence of all kinds, and all reports had by the government in reference to the navigation, cleaning and deepening of the river known as River des Prairies, following along the northern boundary of the island of Montreal. Presented 7th February, 1910.—*Mr. Monk*.  
*Not printed.*
- 107a.** Report of Mr. G. de G. Languedoc, assistant engineer, in respect of work required to be done along Rivière des Prairies, to give a five-foot channel at low water for navigation. Presented 15th February, 1910, by Hon. W. Pugsley. . . . .*Not printed.*
- 108.** Return to an order of the House of Commons, dated 24th January, 1910, showing what interest or control the Canadian Northern Railway Company has in any of the following railway companies: The Ontario and Rainy River Railway Company, the Port Arthur, Duluth & Western Railway Company, the Manitoba & Southeastern Railway Company, the Minnesota & Manitoba Railway Company, the Minnesota & Ontario Bridge Company, the Saskatchewan Northwestern Railway Company, the Qu'Appelle, Long Lake & Saskatchewan Railway Company, the Alberta Midland Railway Company, the Edmonton, Yukon and Pacific Railway Company. 2. What subsidies either in land, money or by way of guarantee of securities have been granted to any of the railway companies mentioned on account of the main or branch lines or both, of the said companies, either by the Dominion government, or the provincial governments of Ontario, Manitoba, Saskatchewan and Alberta, or any municipality through which their lines run. 3. What portion of these subsidies have been earned to date. 4. How many miles west of Edmonton a line of railway is constructed and in operation

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**CONTENTS OF VOLUME 19—Continued.**

- by the Canadian Northern Railway Company. 5. What work other than location survey work has been done west of this point up to date, how much and of what nature. 6. What portion, if any, will eventually form part of the proposed line to Vancouver. 7. When the location plan of the route of the C.N.R. between Edmonton and Vancouver, by way of the Yellow Head Pass was approved by the Minister of Railways and the Board of Railway Commissioners. 8. What applications, if any, have been made since to change or in any way alter this location plan. 9. To what extent, if any, the government of Manitoba has exercised its right of control of freight rates under section 8 of schedule B of the Act 1 Edward VII, chapter 53. 10. What effect, if any, this section of said act has had in reducing freight rates in the province of Manitoba. Presented 8th February, 1910.—*Mr. Lemmor*... ..*Not printed.*
- 109.** Return for the year ended 31st December, 1909, of permits to take intoxicants into the Northwest Territories, in accordance with the requirements of chapter 62, section 88, of the Revised Statutes of Canada. Presented 8th February, 1910, by Hon. F. Oliver. *Not printed.*
- 110.** Return to an order of the House of Commons, dated 6th December, 1909, showing how many officials of the government, or of the Senate or House of Commons, have residences or living rooms in Ottawa supplied by the Crown, with the estimated yearly value and the rent charged in each case. Presented 14th February, 1910.—*Mr. Blain*. *Not printed.*
- 110a.** Supplementary Return to No. 110. Presented 24th February, 1910... ..*Not printed.*
- 111.** Return to an order of the Senate, dated 26th January, 1910, showing the total amount of lands set apart for school purposes in Rupert's Land, or what now comprises the provinces of Manitoba, Saskatchewan and Alberta. The amount of said lands sold for school purposes yearly before the formation of the provinces of Saskatchewan and Alberta, and the average price realized per acre for same. The amount sold yearly in all the said provinces up to the year 1910, and the average price realized for same. The total amount of acres of school lands yet remaining unsold in the said provinces. Presented 15th February, 1910.—*Hon. Mr. Davis*... ..*Not printed.*
- 112.** Return to an order of the House of Commons, dated 6th December, 1909, showing the amount received by the Minister of Finance under the Land Titles Act, section 159, cap. 110, R.S.C., 57 and 58 Vic., cap. 28, sec. 116; how such fund is invested under sec. 160 of the same Act; the amount of interest which has accrued from said fund; and the amount paid for losses arising from bad titles guaranteed by said fund. Presented 22nd February, 1910.—*Mr. Macdonell*... ..*Not printed.*
- 113.** Return to an order of the House of Commons, dated 17th January, 1910, showing: 1. The name, cost, date of construction, place of construction, and gross tonnage of each of the steam vessels now owned by the Dominion government. 2. The names of those built in Canada. 3. What ones thrown open to Canadian competition. 4. In each case that was open to Canadian competition, the difference between the lowest Canadian tender and the price paid. 5. In each case where a contract was made with a builder for the construction of any of said steam vessels, the month and day when each of said contracts were signed, and when each of said contracts called for delivery of vessels. 6. The price each of the said steam vessels would have cost if the government in each case paid the current Canadian customs duty chargeable on vessels constructed outside of Canada. Presented 24th February, 1910.—*Mr. Sinclair*.

*Printed for sessional papers.*

CONTENTS OF VOLUME 19—*Continued.*

- 114.** Return to an order of the House of Commons, dated 15th March, 1909, showing: 1. The number and names of the various dredges owned by the government. 2. When and by whom constructed, or when and from whom purchased. 3. The price paid for each dredge. 4. On what work each dredge has been engaged in in each of the years 1905, 1906, 1907 and 1908. 5. How many months during each of these years each dredge was working, and how many cubic yards of material each dredge removed per month. 6. The cost of maintaining and cost of operating each dredge for each of these years. 7. The names of the dredges leased during these years, if any, to whom leased, on what terms, and what amounts were received each year under such leases. Presented 24th February, 1910.—*Mr. German* . . . . . *Not printed.*
- 115.** Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all letters, telegrams, petitions and other correspondence in connection with the establishing of a post office to be named Charleston or Kelmont, on the south side of Assiniboine river, in the parish of St. Charles, province of Manitoba. Presented 24th February, 1910.—*Mr. Staples* . . . . . *Not printed.*
- 116.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence between the District Officer Commanding Military District Number 11 and the Department of Militia, with reference to the battery of 12 pounder B.L. guns recently sent to Esquimalt, or with reference to the proposal that No. 1 Company of the 5th Regiment, C.A., should train on said guns. Presented 24th February, 1910.—*Mr. Barnard* . . . . . *Not printed.*
- 117.** Return to an order of the House of Commons, dated 7th February, 1910, showing the total cost to Canada of the Military College buildings and grounds, and the amount furnished each year by the government towards its maintenance. Presented 24th February, 1910.—*Mr. Armstrong* . . . . . *Printed for sessional papers.*
- 118.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all papers, affidavits and correspondence between the Interior Department and John A. Dunn, or anyone in his behalf, and any official of the department, concerning the application for patent of the n.w.  $\frac{1}{4}$  sec. 31, tp. 35, range 16, west of the 2nd meridian. Presented 24th February, 1910.—*Mr. Roche* . . . . . *Not printed.*
- 119.** Statement of the affairs of the British Canadian Loan and Investment Company (Limited), for the year ended 31st December, 1909. Also a list of the shareholders on 31st December, 1909, in accordance with chapter 57 of 39 Victoria. Presented (Senate) 25th February, by the Hon. the Speaker . . . . . *Not printed.*
- 120.** Return to an order of the Senate, dated 23rd November, 1909, for a copy of each charter granted since 1st June, 1909, by the Secretary of State, by letters patent under The Companies Act, chapter 79 of the Revised Statutes, 1906. (a) Incorporating any company with powers for the development, production, distribution or use of water power for any purposes; or with powers for the production, distribution and use of water power for any purposes; or with powers for the production, distribution and use of electricity in any form by any means, whether directly or by the transformation thereof into heat, light, power or any other kind of energy; or (b) conferring such powers upon any company previously incorporated. Presented 1st March, 1910.—*Hon. Mr. David* . . . . . *Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 121.** Return to an order of the House of Commons, dated 14th February, 1910, showing the amounts that have been paid to the *Whig* Publishing Company for printing and advertising by or for any departments of this government other than Militia and Defence and Marine and Fisheries, each year, from 1896 to the present time. Presented 2nd March, 1910.—*Mr. Edwards*... ..*Not printed.*
- 121a.** Supplementary Return to No. 121. Presented 10th March, 1910... ..*Not printed.*
- 122.** Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all letters, correspondence, papers, bills and memorials, passing between the government of the province of Manitoba and the Dominion government since 1st January, 1907. Presented 2nd March, 1910.—*Mr. Roche*... ..*Not printed.*
- 122a.** Return to an address of the House of Commons, dated 28th February, 1910, and also of the Senate, dated 24th February, 1910, for a copy of all correspondence between the Dominion government and the government of Manitoba on the subject of the extension of the boundaries of the province of Manitoba since the resolution adopted by the House of Commons on the 13th day of July, 1908. Presented 2nd March, 1910.—*Hon. Mr. Watson and Mr. Molloy*... ..*Not printed.*
- 123.** Return to an address of the Senate, dated 3rd February, 1910, for the production of all correspondence between the Honourable George E. Foster, M.P., and the government of Canada, or any of their members since the year 1878, in relation to appointment of judges to the judicial bench and of members to the Senate of Canada. Presented 6th April, 1910.—*Hon. Mr. Cloran*... ..*Not printed.*
- 124.** Return to an order of the House of Commons, dated 28th February, 1910, showing all sums of money received by the *Soleil* Publication Company, the *Vigie* Publication Company, and the *Daily Telegraph* Publication Company of Quebec, from the different federal departments, and from the Transcontinental Commission, since the first day of March, 1908, and the respective dates of each payment. Presented 3rd March, 1910.—*Mr. Paquet*... ..*Not printed.*
- 125.** Return to an order of the House of Commons, dated 29th November 1909, for a copy of all correspondence, reports, advertisements, tenders, contracts and other papers and documents relative to the maintenance of a wrecking plant on the Pacific or Atlantic coasts, or in the River or Gulf of St. Lawrence, not already brought down. Presented 3rd March, 1910.—*Mr. Taylor (Leeds)*... ..*Not printed.*
- 126.** Return to an order of the House of Commons, dated 19th January, 1910, showing how much money has been paid by this government in each year from 1896 to 1909, both years included, to the firms of Elliott Bros., and of R. Carson, of Kingston, Ontario, for supplies furnished to, or services of any kind performed by the government. Presented 4th March, 1910.—*Mr. Edwards*... ..*Not printed.*
- 127.** Return to an order of the House of Commons, dated 19th January, 1910, showing:  
1. The amount of Canada's copper, silver, and gold coinage, respectively, for each of the last ten years, and the cost and profit of each year's coinage, counting the interest and depreciation of the cost of the Canadian Mint at 6 per cent, and the cost of maintenance and staff for the years during which it has been in operation. 2. The amount of United States silver, and at what cost that has been deported each year, and the estimated amount of United States silver current in Canada from year to year. Presented 4th March, 1910.—*Mr. Foster*... ..*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 128.** Return to an order of the House of Commons, dated 7th February, 1910, showing the number of chartered banks that have gone into liquidation since 1888, the date of the charters of each, the date of suspension, the capital stock, assets and liabilities, respectively, at date of suspension, and the per cent of dividends paid to both holders and depositors respectively. Also what other banks have disappeared by amalgamation or otherwise, with similar information as above in respect to them. Presented 4th March, 1910.—*Mr. Foster*... ..*Not printed.*
- 129.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all memorials, reports, correspondence and documents not already brought down, including report of the survey made during the past summer and autumn of the harbour at Cape John and Tatamagouche Bay, in the counties of Pictou and Colchester, in the province of Nova Scotia, relating to the route of the winter steamers between Prince Edward Island and the mainland of Canada, and suggesting and recommending a change or changes in the said route, and an increase in the number of trips daily of such winter steamers; and also a copy of all memorials, reports, correspondence and documents relating to the route of the summer mail steamers between Charlottetown and the mainland of Canada, and suggesting a change or changes in that route, and an increase in the number of trips daily of such summer mail steamers; and also with regard to connecting such suggested new summer route or routes with a point or points on the Intercolonial Railway; and also for a copy of all memorials, and correspondence, asking for additional and improved aids to navigation of the harbour of Charlottetown and in Tatamagouche Bay and harbour. Presented 4th March, 1910.—*Mr. Warburton*... ..*Not printed.*
- 130.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all reports of surveys of any projected railway lines or routes in the province of Prince Edward Island during the years 1908 and 1909, and particularly reports of the surveys of any such line from Royal Junction, or thereabouts, to Kensington or thereabouts; also of all correspondence, recommendations, documents and papers of every kind, nature and description relating to or concerning the said projected railway lines or routes or the surveys therefor. Presented 6th March, 1910.—*Mr. Borden*...*Not printed.*
- 130a.** Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all memorials, reports of surveys, engineers' reports, estimates, correspondence and documents in the possession of the Department of Railways and Canals, and of the Intercolonial Railway Commission, relating to the survey and construction of a proposed branch of the Prince Edward Island Railway through New London and along the north shore of Queens County, in that island. Presented 8th April, 1910.—*Mr. Warburton*.  
*Not printed.*
- 131.** Return to an order of the Senate, dated 22nd February, 1910, for a comparative statement for the years 1907, 1908 and 1909, of crude petroleum oil imported into Canada, and values. Presented 4th March, 1910.—*Hon. Mr. Dorrville*... ..*Not printed.*
- 132.** Return to an order of the House of Commons, dated 28th February, 1910, for a copy of reports of the following Quarantine Frontier Inspectors:—Dr. Bradford, Dr. Carter, Dr. Duncan, Dr. Thornton, Dr. Wallace, Dr. May, Dr. McKenty, Dr. Little, Dr. Henderson and Dr. Scott. Presented 9th March, 1910.—*Mr. Sharpe (Lisgar)*...*Not printed.*
- 133.** Report of the Hydrographic Survey, in connection with Irrigation, for the season of 1909. Presented 10th March, 1910, by Hon. F. Oliver.

*Printed for both distribution and sessional papers.*

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**CONTENTS OF VOLUME 19—Continued.**

- 134.** Return to an order of the House of Commons, dated 17th February, 1909, showing particulars of the places where the expenditures mentioned in column 365, unrevised *Hansard*, for wharfs in Nova Scotia, New Brunswick and British Columbia, where made, together with amounts expended in each instance for construction and repairs, respectively. Presented 10th March, 1910.—*Mr. Barnard*. . . . .*Not printed.*
- 135.** Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all petitions addressed to the government or any member thereof, as well as of all letters, correspondence and reports in the possession of the government, and having reference to repairs required at two wharfs built by the government and situated at Ste. Genevieve and Isle Bizard, in Jacques Cartier County, P.Q., and also all the correspondence concerning the construction of those wharfs, and of their use as piers for a bridge. Presented 11th March, 1910.—*Mr. Monk*. . . . .*Not printed.*
- 136.** Return to an order of the House of Commons, dated 17th January, 1910, showing the foreign exhibitions in which Canada has taken part since July, 1896, the time and place where such was held, the expenditure thereon by the government of Canada, the persons, not common labourers, who had charge of the same or were employed thereat, the sums paid to such severally under the heads of (a) salary, (b) expenses, and the total cost to the country of each such exhibition; also the amounts received as revenue from the sale of articles or commodities, lumber, buildings and other materials, respectively. The whole statement to be made up in tabular form and the additions of money columns to be made. Presented 11th March, 1910.—*Mr. Foster*.  
*Printed for sessional papers.*
- 137.** Return to an order of the Senate, dated 18th February, 1910, for a statement showing the number of homestead entries, pre-emptions, scrip locations and military warrant locations in townships 35, 36, 37, 38 and 39, in ranges 1 to 19, inclusive, of 4th meridian, and in townships 32, 33 and 34, in ranges 1 to 8 inclusive, west of 4th meridian. Presented 16th March, 1910.—*Hon. Mr. Talbot*. . . . .*Not printed.*
- 138.** Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all correspondence between the government, or any member thereof, and the Imperial South African Service Association, or any of its officers, in reference to a proposed military reserve to be formed by the members of the Imperial South African Veterans' Association. Presented 17th March, 1910.—*Mr. Macdonald*. . . . .*Not printed.*
- 139.** Return to an address of the House of Commons, dated 18th February, 1910, for a copy of all orders in council, correspondence, reports, documents and papers, relating to the right or privilege to raise the waters of Clear Lake, province of Manitoba, application for which was made by a company to develop power on the Little Saskatchewan river. Presented 21st March, 1910.—*Mr. Roche*. . . . .*Not printed.*
- 140.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence, advertisements, tenders and other documents, in connection with a proposal or proposals to lease a part or the whole of the Black Foot Reserve. Presented 21st March, 1910.—*Mr. Mayrath*. . . . .*Not printed.*
- 141.** Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all correspondence, reports, documents and papers relating to the strike of the employees of the Dominion Coal Company and the Cumberland Coal and Railway Company, in the counties of Cape Breton and Cumberland, Nova Scotia. Presented 23rd March, 1910.—*Mr. Rhodes*. . . . .*Not printed.*

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**CONTENTS OF VOLUME 19—Continued.**

- 141a.** Supplementary Return to No. 141. Presented 13th April, 1910. . . . .*Not printed.*
- 142.** Return to an order of the House of Commons, dated 20th November, 1909, showing the total amounts paid by the government in each year since 1896, for all printing, advertising and lithographing done outside of the Government Printing Bureau; the total amount so paid by each department of the government for such purposes during each year; the names and addresses of each individual, firm or corporation to whom any such moneys have been so paid, and the total amount paid to each individual, firm or corporation in each year since 1896. What portion of the said sums, if any, so paid since 1896, was expended after public advertisement, tender and contract, to whom such tenders were awarded, whether to the lowest tender in each case, what portion was expended otherwise than by public advertisement, tender and contract, and to whom it was paid in each instance. Presented 23rd March, 1910.—*Mr. Armstrong.*  
*Not printed.*
- 143.** Return to an order of the House of Commons, dated 19th January, 1910, showing: 1. How much money has been paid by this government from 1896 to the present time to the firm of Sullivan & Langdon, contractors, of Kingston, or to Mr. Sullivan, contractor, Kingston. 2. What public buildings or other public works that have been let by contract to either of the above firms since 1896, the contract price in each case, and the total amount paid to the said contractors in each case. 3. The total cost of each building or public work in which either of the above mentioned firms was interested. Presented 23rd March, 1910.—*Mr. Edwards.* . . . . .*Not printed.*
- 144.** Return to an order of the House of Commons, dated 19th January, 1910, showing: 1. All amounts which may be deducted from the allowances due officers commanding corps of the active militia to cover deficiencies in clothing, &c., deposited to the credit of the Receiver General of Consolidated Revenue. 2. The amount of money that has been received from officers commanding corps of active militia during the five years ended 31st March, 1909, in payment for clothing issued to such corps, including deductions from allowances to cover repayment to replace deficiencies. Presented 30th March, 1910.—*Mr. Worthington.* . . . . .*Not printed.*
- 145.** Rules of the Supreme Court of Saskatchewan, under the provisions of section 576 of the Criminal Code. Presented 30th March, 1910, by Hon. A. B. Aylesworth.  
*Not printed.*
- 146.** Copy of correspondence between the Canadian government and the government of Great Britain in respect to the purchase by Canada of the cruiser *Rainbow*. Presented 30th March, 1910, by Sir Wilfrid Laurier. . . . .*Printed for sessional papers.*
- 146a.** Copy of correspondence between the Canadian government and the government of Great Britain in respect to the purchase of the cruiser *Niobe*. Presented 30th March, 1910, by Sir Wilfrid Laurier. . . . .*Printed for sessional papers.*
- 147.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence respecting the Central Park Post Office during the year 1909 and including particularly a copy of: 1. Representations made to the department that by changing the location of the office and establishing a post office at Collingwood East, the interest of the majority of the residents would be best served. 2. The evidence taken at the inquiry following such representations, and the official report upon such evidence. 3. Communications from residents of Central Park and others with respect to the closing of the post office there, and the answer made thereto in accordance with the facts. 4. The information upon which it was determined that the removal of the post office would be a greater convenience. 5. The largely signed petition from patrons

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**CONTENTS OF VOLUME 19—Continued.**

of the Central Park Post Office complaining of the management, &c.; and the report of the inspector who investigated the same. Presented 31st March, 1910.—*Mr. Taylor (New Westminster)*.. . . .*Not printed.*

- 148.** Return to an order of the House of Commons, dated 14th March, 1910, showing, for the last two months, the time of each transmission of mails from Montreal to London, England, and from London, England, to Montreal and showing the date and hour of closing, and date and hour of delivery in each case. Presented 31st March, 1910.—*Mr. Monk*.. . . .*Not printed*
- 149.** Return to an order of the House of Commons, dated 14th March, 1910, showing the names of the sessional and temporary employees of the House of Commons who were under pay on the 27th January last; and the number of the said employees stated in the estimates of 1909-10. Presented 31st March, 1910.—*Mr. Best.*  
*Printed for sessional papers.*
- 150.** Return to an order of the House of Commons, dated 24th January, 1910, for a copy of all correspondence between Celstin Prgent, of Melocheville, P.Q., either personally or through his attorney, and the Department of Railways and Canals, concerning certain bridges on the Beauharnois canal. Presented 31st March, 1910.—*Mr. Monk.*  
*Not printed.*
- 151.** Return to an order of the House of Commons, dated 14th March, 1910, showing what amount of money has been paid each year to Geo. Walton, Manitoba, by the Interior Department, from January 1st, 1906, to December 31st, 1909; and what monies Mr. Geo. Walton has received since January 1st, 1906, from any other department of the government. Presented 4th April, 1910.—*Mr. Schaffner*.. . . .*Not printed.*
- 152.** Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence relating to all coal lands reserved for as well as those acquired by the Bow River Collieries by direct application or assignment. Presented 4th April, 1910.—*Mr. Northrup*.. . . .*Not printed.*
- 153.** Report of Harry Freeman Alward, Commissioner appointed to investigate into the matter of complaints concerning James Dickson, government valuator, Trent canal, pursuant to Part II, of the Inquiries Act, Revised Statutes of Canada, 1906, held at Peterborough and Hastings, Ontario, March 2th to March 29th, inclusive, 1910; and also a copy of the evidence in relation thereto. Presented 5th April, 1910, by Hon. G. P. Graham.. . . .*Not printed.*
- 154.** Return to an order of the Senate, dated 14th January, 1910, for a statement comprising, in so many distinct columns, the names, dates and appointment, nature of employment, salary, travelling expenses, and indication of the section where the person was employed, of all persons in the service of the Commission for the construction of the Grand Trunk Pacific Railway between Moncton and Winnipeg. Presented 6th April, 1910.—*Hon. Mr. Bolduc*.. . . .*Not printed.*
- 155.** Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all pay-sheets, accounts, and vouchers for wages, material and expenditure in connection with work on Skinner's Cove, Boat Harbour, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 8th April, 1910.—*Mr. Stanfield*..*Not printed.*



CONTENTS OF VOLUME 19—*Continued.*

- 155a.** Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all payments, accounts and vouchers for wages, materials and other expenditures in connection with work on the Toney river, Boat Harbour, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 8th April, 1910.—*Mr. Rhodes.*  
*Not printed.*
- 156.** Return to an order of the House of Commons, dated 15th December, 1909, showing: At what places in the several provinces armouries and drill halls have been erected, and when they were erected; the total cost of the site in each case, and when and from whom purchased; the contract price of each building, and to whom and when the contract was awarded; the total cost of each building; in what places armouries and drill halls are being constructed at present, and the cost of the site, from whom and when purchased; the estimated cost of the building in each case, and to whom, when and at what price the contract was awarded, and the names of places other armouries and drill halls are to be built by the government in the near future. Presented 8th April, 1910.—*Mr. Edwards.* . . . . .*Not printed.*
- 156a.** Supplementary Return to No. 156. Presented 14th April, 1910. . . . .*Not printed.*
- 157.** Return to an order of the House of Commons, dated 28th February, 1910, for a copy of all correspondence, accounts, vouchers and reports, relating to the accident at Sault Ste. Marie lock in June, 1909; the number of vessels and tonnage with port of destination, and number of passengers passing through the Canadian lock at Sault Ste. Marie, during the months of April to December, both inclusive, 1909. Presented 8th April, 1910.—*Mr. Boyce.* . . . . .*Not printed.*
- 158.** Return to an order of the House of Commons, dated 28th February, 1910, for a copy of the original field notes of the survey of Captain Jemmett, 1889, on Chu-Chu-Way-Ha Reserve, No. 2, Similkameen District, B.C. Presented 14th April, 1910.—*Mr. Burrell.*  
*Not printed.*
- 159.** Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all pay sheets, accounts and vouchers for wages, materials and other expenditures in connection with work on the Causeway between Cariboo and Cariboo Island, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 14th April, 1910.—*Mr. Borden (Halifax).* . . . . .*Not printed.*
- 160.** Statement of representation made to the Honourable the Minister of Labour by interviews and in the form of correspondence in respect of Bill No. 101, 'An Act for the investigation of combines, monopolies, trusts and mergers which may enhance prices or restrict competition to the detriment of consumers.' Presented 14th April, 1910, by Hon. W. L. M. King. . . . .*Not printed.*
- 161.** Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all papers and correspondence relating to the sale and refund of the money paid on the sale of the n.e.  $\frac{1}{4}$  section of section 11, township 1, range 9, west of the 1st meridian in Manitoba. Presented 15th April, 1910.—*Mr. Sharpe (Lisgar).* . . . . .*Not printed.*
- 162.** Return to an order of the Senate, dated 7th April, 1910, for a copy of all correspondence or petitions received by the government from Manitoba grain growers in connection with terminal elevators, especially a letter dated the 31st January, 1910. Presented 14th April, 1910.—*Hon. Mr. Kirchhoffer.* . . . . .*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

- 163.** Return to an address of the Senate, dated 11th March, 1910, for the production of the report of every inquiry made and of all correspondence exchanged during the last five years on the subject of one or more seizures of goods consigned to or the property of the Quebec Rock City Tobacco Company, as well as on the subject of every remission of fines incurred by the said company for infraction of the Inland Revenue laws or regulations. Presented 14th April, 1910.—*Hon. Mr. Landry*. . . . .*Not printed.*
- 164.** Return to an order of the House of Commons, dated 7th February, 1910, showing the number of persons appointed as temporary employees of the civil service in the several departments since the present Civil Service Act came into force, the date of the appointment of each, their names, their salaries while employed as such temporary employees, the department in which such employee was placed, the duration of their employment, whether in one department alone or in case of transfer to another or other department, with total length of time employed, the names of those who in consequence or having passed the Civil Service examination have been employed permanently, the names of those who while temporarily employed failed to pass the required examination and are still employed in the service; the names of those who are or have been employed over the statutory six months as temporary employees, and the reasons for such continued employment in each case. Presented 18th April, 1910.—*Mr. Hughes*.  
*Not printed.*
- 165.** Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all papers, letters, telegrams, documents and correspondence in connection with the establishment of the Experimental Farm near Lethbridge, Alta. Presented 18th April, 1910.—*Mr. Magrath*. . . . .*Not printed.*
- 166.** Certified copies of reports of the Committee of the Privy Council of 17th January, 1908, and of the 14th November, 1908, respecting a homestead entry granted to Mr. Charles D. T. Becher, for the n.e.  $\frac{1}{4}$  of section 20, township 52, range 24, west of the fourth meridian, &c. Presented 18th April, 1910, by Hon. F. Oliver. . . . .*Not printed.*
- 167.** Return to an order of the Senate, dated 10th February, 1910, of all surveys, plans, reports and other documents connected with the improvement of the Saskatchewan river, with a view to facilitate transportation by water of passengers and freight from the foot of the Rocky Mountains to the city of Winnipeg, Man. Presented 19th April, 1910.—*Hon. Mr. Davis*. . . . .*Not printed.*
- 168.** Return to an order of the House of Commons, dated 24th November, 1909, for a copy of all correspondence and papers, and any information possessed by the government relating to the formation and work of the Secretariat decided upon by the Imperial Conference of 1907. Presented 20th April, 1910.—*Mr. Foster*.  
*Printed for both distribution and sessional papers.*
- 169.** Correspondence between the Clerk of the House and the Department of Justice with reference to the organization of the staff of the House of Commons. Presented 21st April, 1910, by Hon. W. S. Fielding. . . . .*Not printed.*
- 170.** Certified copy of a report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 15th April, 1910, in respect to chapter 10 of the Statutes of Ontario, 1909, intituled: 'An Act to amend an Act to chapter 19 of the Statutes of Ontario, 1909,' intituled: 'An Act to amend an Act to provide for the transmission of Electrical Power to Municipalities,' to validate certain contracts entered into with the Hydro-Electric Power Commission of Ontario, and for other purposes.' Presented 25th April, 1910, by Hon. A. B. Aylesworth. . . . .*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

- 171.** Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all papers and correspondence between different persons or companies and the Department of Mines, in reference to a charge of unprofessional conduct made in the *Canadian Mining Journal* of July 1, 1909, against Mr. Fritz Circle, a mining engineer, temporarily employed by the Department of Mines in preparing a report on the asbestos mining industry of the province of Quebec. Presented 27th April, 1910.—*Mr. Smith (Nanaimo)*.. . . .*Not printed.*
- 172.** Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all letters, communications, petitions and correspondence with and by the government or any minister, with regard to the acquiring or building by the Government of Terminal Elevators at any point or points in Canada. Presented 27th April, 1910.—*Mr. Campbell*.. . . .*Not printed.*
- 172a.** Report of the investigation of the terminal elevator companies. Presented 29th April, 1910, by Hon. Frank Oliver.. . . .*Not printed.*
- 173.** Return to an order of the Senate, dated 21st January, 1910, for a copy of the contract entered into between Messrs. Koenig & Company, and the government, for clearing away the ruins of the Quebec bridge. Presented 28th April, 1910.—*Hon. Mr. Landry*.  
*Not printed.*
- 174.** Return to an order of the Senate, dated 10th March, 1910, for a statement regarding Indian affairs in British Columbia for the years 1908 and 1909, showing.—The number of persons and place of residence to whom salaries are paid and the amounts. The number of Indians to whom food or clothing were given, in what districts, and the value. How many hospitals are there for Indians, in what districts, how many Indians treated, and the cost. The number of agents travelling, how many trips in the year, what are the allowances per day. How many offices are rented, in what localities, and the rent paid. How many Indian orchards were cleared and where. How many Indians received seed and implements, and where. Presented 29th April, 1910. *Hon. Mr. Macdonald (B.C.)*.. . . .*Not printed.*
- 175.** Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all correspondence, papers, affidavits, cancellations, &c., in connection with the entry of Wm. Reid Gardiner, for the n.w.  $\frac{1}{4}$  section 22, township 35, range 16, west of the 2nd meridian. Presented 2nd May, 1910.—*Mr. Roche*.. . . .*Not printed.*
- 176.** Return to an order of the House of Commons, dated 15th December, 1909, for a copy of the report, plans and correspondence in the hands of the government regarding the construction of branch post offices and postal substations in and around the city of Montreal, and of all proposals and suggestions made to the government by the post office authorities at Montreal for the establishment, in a systematic way, of postal branches and substations in said city and suburbs. Presented 2nd May, 1910.—*Mr. Monk*.. . . .*Not printed.*
- 176a.** Supplementary Return to No. 176. Presented 4th May, 1910.. . . .*Not printed.*
- 177.** Return to an order of the House of Commons, dated 28th February, 1910, for a copy of all papers, correspondence and petitions in reference to the changing of the post office at Windygates, in the province of Manitoba. Presented 2nd May, 1910. *Mr. Sharpe (Lisgar)*.. . . .*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

- 178.** Return to an order of the House of Commons, dated 25th February, 1910, for a copy of all representations made by business or commercial men or citizens of Winnipeg to the department or government since the contemplated action of the government in reference to closing or keeping open the post office to box holders on Sundays, and who made them; and of all orders given by the Postmaster General or his department to the postmasters in reference to this Sunday closing. Presented 2nd May, 1910.—*Mr. Haggart (Winnipeg)* . . . . .*Not printed.*
- 178a.** Supplementary Return to No. 178. Presented 2nd May, 1910. . . . .*Not printed.*
- 179.** Return to an order of the House of Commons, dated 17th November, 1909, for a copy of all accounts, vouchers, correspondence, reports and other papers, not already brought down in connection with the survey of the St. John River channel between Fredericton and Woodstock, N.B. Presented 2nd May, 1910.—*Mr. Crockett* . . . . .*Not printed.*
- 180.** Return to an address of the Senate, dated 17th March, 1910, for all documents, letters, returns, &c., concerning the damming of the river La DéCharge, near Lake St. John, in the district of Chicoutimi; which returns are to the effect of showing whether it would be possible to maintain the level of Lake St. John at a reasonable height in order to ensure serviceable navigation on that lake and its tributaries. Presented 2nd May, 1910.—*Hon. Mr. Choquette* . . . . .*Not printed.*
- 181.** Return to an address of the House of Commons, dated 14th February, 1910, for a copy of all orders in council, reports, correspondence, documents and papers not already brought down relating to the construction of the Georgian Bay canal, or any portion thereof, relating to the surveys thereof, and all offers, proposals and written negotiations not already brought down, with respect to the construction of the said canal or any portion thereof by any company, corporation or syndicate, or with respect to the guarantee by the government of bonds or debentures for the purpose of raising the necessary capital for the construction of the said canal. Presented 3rd May, 1910.—*Mr. White (Renfrew)* . . . . .*Not printed.*
- 182.** Return to an address of the House of Commons, dated 17th January, 1910, showing the various commissions appointed for all purposes by the government since July 1896, the person or persons composing the commission and the date of appointment, the purpose for which appointed, the date of completion of the work in each case, and the cost of each under the head (a) salary, (b) travelling expenses, and (c) printing report, if any; the word 'commissions' to include the missions of ministers, single or associated, going on public account to the countries outside of Canada. Presented 3rd May, 1910.—*Mr. Foster* . . . . .*Not printed.*
- 182a.** Supplementary Return to No. 182. Presented 3rd May, 1910. . . . .*Not printed.*
- 183.** Return to an order of the House of Commons, dated 28th February, 1910, showing the number of persons in the employ of each department of the government during the year 1909 under the following heads: (a) civil service employees at Ottawa; (b) civil service employees outside of Ottawa; (c) in stated and regular employ, but not under the Civil Service Act, giving the distinctive service of each group; (d) those in temporary or casual employment, giving the distinctive work of each group, and also showing the total amount paid under each head. Presented 3rd May, 1910.—*Hon. Mr. Foster* . . . . .*Not printed.*
- 184.** Return to an order of the Senate, dated 2nd May, 1910, showing for each of the last ten years the date of the prorogation of parliament and the date on which the bound statutes of the session were distributed. Presented 4th May, 1910.—*Hon. Mr. Power* . . . . .*Not printed.*

# ANNUAL REPORT

OF THE

# DEPARTMENT OF THE INTERIOR

FOR THE

Fiscal Year ending March 31, 1909

*PRINTED BY ORDER OF PARLIAMENT*



OTTAWA

PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST  
EXCELLENT MAJESTY

1909

[No. 25—1909.]



*To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey,  
G.C.M.G., &c., &c., Governor General of Canada.*

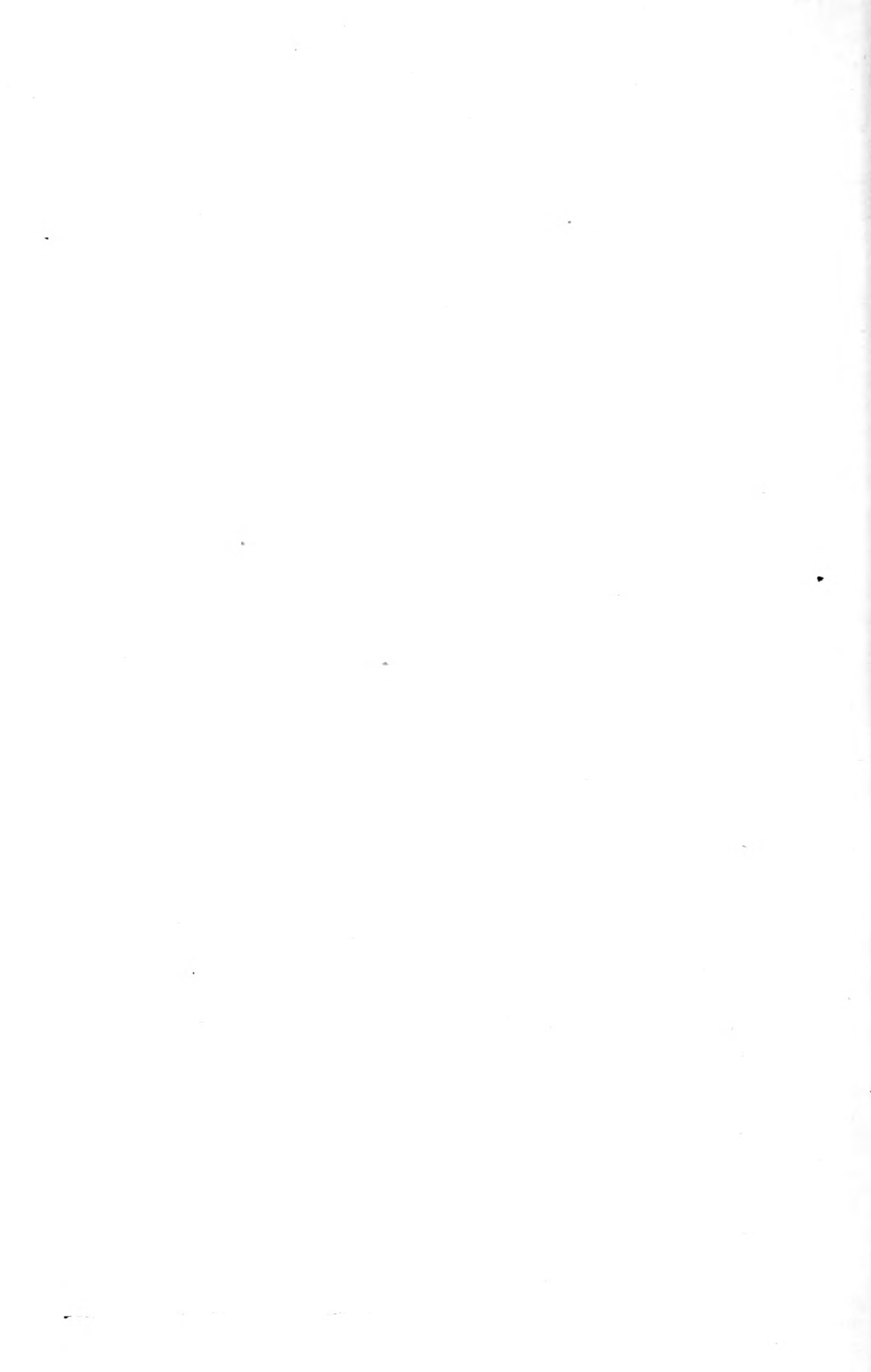
MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency the report of the transactions of the Department of the Interior for the fiscal year ending March 31, 1909.

Respectfully submitted,

FRANK OLIVER,  
*Minister of the Interior.*

OTTAWA, AUGUST 2, 1909.





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**REPORT**  
OF THE  
**DEPUTY MINISTER OF THE INTERIOR**  
**1908-9**

DEPARTMENT OF THE INTERIOR,

OTTAWA, July 15, 1909.

The Honourable FRANK OLIVER,  
Minister of the Interior.

SIR,—I have the honour to submit the thirty-sixth Annual Report of the Department of the Interior, for the twelve months ending March 31, 1909.

As evidenced by the statements submitted by the chief officers in charge of the various services of the department, the general results obtained have been highly satisfactory. The net revenue derived on account of Dominion lands has been the largest in the history of the department, and while there has been a falling off in the total emigration to Canada, there has been a substantial increase in the number of free homestead entries granted to agriculturists, as compared with the previous year. The work in consequence has been unusually heavy, especially as a result of the opening up to pre-emption and homestead entry of all the available odd numbered sections in the provinces of Manitoba, Saskatchewan and Alberta on September 1, last. However, I am glad to be in a position to state that the recent amendments made to the Dominion Lands Act, coupled with the framing, under your immediate supervision, of rulings and regulations for the guidance of agents and the general information of the public, have contributed largely to simplifying the land administration of the department; and to these factors chiefly must be attributed the success attending the efforts of the officers in charge of the land agencies in the west in properly dealing with the tremendous increase in work in most of the offices.

It is to be hoped that it may be possible at an early date to similarly consolidate the Immigration Act and to bring about such changes and amendments to the present law as may facilitate the administration of this important branch of the department.

## DEATHS.

I regret to have to report that there were ten deaths in the department during the past year, namely four at headquarters and six in the outside service. The following is a list of the persons who have died:—

## Head Office—

- Mrs. J. Ricard, Secretary's Branch, died November 20, 1908.  
 Mederie Marin, Registration Branch, died November 24, 1908.  
 Wm. F. Ratz, D.L.S., Surveys Branch, died February 6, 1909.  
 C. G. Wood, Geographer's Branch, died February 24, 1909.

## Outside Service—

- Miss Ella Carr, Immigration Office, Winnipeg, died April 16, 1908.  
 R. S. Cook, agent Dominion Lands, Prince Albert, died October 27, 1908.  
 Mrs. Julia Marquette, matron Immigration Hospital, Quebec, died November 1, 1908.  
 T. H. Ritchie, guardian, Detention Hospital, St. John, N.B., died December 31, 1908.  
 Alexander Bailey, Immigration Office, Halifax, N.S., died January 5, 1909.  
 Geo. Noot, Immigration Boundary Inspector, White Horse Pass, died January 25, 1909.

STATEMENT showing Gross Cash Revenue received from all Sources during the Fiscal Year ended March 31, 1909, compared with Receipts for the previous Fiscal Year.

| Source of Revenue.                   | Fiscal Year 1908-9. |      | Fiscal Year 1907-8. |      | Increase. | Decrease. | Net Increase.        |
|--------------------------------------|---------------------|------|---------------------|------|-----------|-----------|----------------------|
|                                      | \$                  | cts. | \$                  | cts. |           |           |                      |
| Dominion Lands.....                  | 2,254,283           | 98   | 1,998,219           | 92   | 256,064   | 06        |                      |
| School Lands.....                    | 687,422             | 74   | 708,045             | 83   |           |           | 20,623 09            |
| Ordnance Lands.....                  | 203,749             | 96   | 8,674               | 95   | 197,075   | 01        |                      |
| Seed Grain.....                      | 53,590              | 86   | 12,899              | 84   | 40,691    | 02        |                      |
| Casual Revenue.....                  | 26,224              | 29   | 20,069              | 03   | 6,155     | 26        |                      |
| Registration Fees (Yukon).....       | 1,352               | 13   | 2,256               | 65   |           |           | 904 52               |
| Fines under the Immigration Act..... | 40                  | 00   | 1,650               | 00   |           |           | 1,610 00             |
| Fines and Forfeitures, N.W.T.....    | 241                 | 00   |                     |      | 241       | 00        |                      |
| Total.....                           | 3,228,904           | 96   | 2,751,816           | 22   | 500,226   | 35        | 23,187 61 477,088 74 |

## SESSIONAL PAPER No. 25

STATEMENT of Receipts on account of Dominion Lands Revenue for the Fiscal Year ended March 31, 1909, as compared with the Receipts for the previous year. (Net Cash Revenue.)

| Particulars.                         | 1908-1909. |      | 1907-1908. |      | Increase. |      | Decrease. |      | Net Increase. |      |
|--------------------------------------|------------|------|------------|------|-----------|------|-----------|------|---------------|------|
|                                      | \$         | cts. | \$         | cts. | \$        | cts. | \$        | cts. | \$            | cts. |
| Homestead fees .....                 | 389,039    | 00   | 301,693    | 73   | 87,345    | 27   |           |      |               |      |
| Pre-emption fees .....               | 141,550    | 15   |            |      | 141,550   | 15   |           |      |               |      |
| Purchased homestead fees.....        | 8,245      | 00   |            |      | 8,245     | 00   |           |      |               |      |
| Improvements .....                   | 70,928     | 86   | 71,139     | 47   |           |      | 210       | 61   |               |      |
| Sales of lands .....                 | 951,442    | 28   | 656,303    | 03   | 295,139   | 25   |           |      |               |      |
| Map sales, office fees, &c.....      | 7,296      | 55   | 7,727      | 29   |           |      | 430       | 74   |               |      |
| Rentals of lands.....                | 9,986      | 86   | 5,309      | 01   | 4,677     | 85   |           |      |               |      |
| Survey fees.....                     | 42,388     | 31   | 141,255    | 35   |           |      | 98,867    | 04   |               |      |
| Timber dues.....                     | 269,837    | 52   | 473,608    | 94   |           |      | 203,771   | 42   |               |      |
| Grazing lands.....                   | 53,312     | 79   | 43,211     | 78   | 10,101    | 01   |           |      |               |      |
| Coal lands.....                      | 55,535     | 89   | 29,697     | 64   | 25,838    | 25   |           |      |               |      |
| Hay permits.....                     | 5,921      | 80   | 4,976      | 45   | 945       | 35   |           |      |               |      |
| Mining fees.....                     | 92,637     | 60   | 130,703    | 55   |           |      | 38,065    | 95   |               |      |
| Hydraulic leases.....                | 4,488      | 81   | 6,248      | 97   |           |      | 1,760     | 16   |               |      |
| Dredging leases.....                 | 11,188     | 34   | 13,616     | 84   |           |      | 8,428     | 50   |               |      |
| Export tax on gold.....              | 81,585     | 07   | 70,504     | 65   | 11,080    | 42   |           |      |               |      |
| Free certificates for export of gold | 166        | 00   | 162        | 50   | 3         | 50   |           |      |               |      |
| Stone quarries .....                 | 906        | 38   | 1,270      | 93   |           |      | 364       | 55   |               |      |
| Irrigation fees.....                 | 307        | 00   | 516        | 75   |           |      | 149       | 75   |               |      |
| Rent of water power.....             | 542        | 28   | 2,640      | 78   |           |      | 2,098     | 50   |               |      |
| Fees of Board of Examiners, D.L.S.   | 1,040      | 00   | 690        | 00   | 350       | 00   |           |      |               |      |
| Patent and interchange fees.....     | 1,334      | 70   | 1,283      | 50   | 51        | 00   |           |      |               |      |
| Rocky Mountains Park.....            | 31,321     | 20   | 27,232     | 87   | 4,088     | 33   |           |      |               |      |
| Free miners' certificates.....       |            |      | 76         | 25   |           |      | 76        | 25   |               |      |
| Suspense account.....                | 4,333      | 16   | 1,385      | 35   | 2,947     | 81   |           |      |               |      |
| Refunds of refunds.....              | 18,105     | 25   | 692        | 77   | 17,412    | 49   |           |      |               |      |
| Miscellaneous.....                   | 783        | 37   | 271        | 52   | 511       | 85   |           |      |               |      |
|                                      | 2,254,283  | 98   | 1,998,219  | 92   | 610,287   | 53   | 354,223   | 47   |               |      |
| Refunds.....                         | 101,029    | 37   | 114,600    | 04   |           |      | 13,570    | 67   |               |      |
|                                      | 2,153,254  | 61   | 1,883,619  | 88   | 610,287   | 53   | 340,652   | 80   | 269,634       | 73   |

STATEMENT showing yearly the Gross Revenue (in cash only) received from all sources from July 1, 1886, to March 31, 1909.

| Fiscal Year.                 | Dominion Lands (Cash.) |      | School Lands. |      | Seed Grain. |      | Ordnance Lands. |      | Fines and Forfeitures. |      | Registration Fees. |      | Casual Revenue. |      | Total.     |    |
|------------------------------|------------------------|------|---------------|------|-------------|------|-----------------|------|------------------------|------|--------------------|------|-----------------|------|------------|----|
|                              | \$                     | cts. | \$            | cts. | \$          | cts. | \$              | cts. | \$                     | cts. | \$                 | cts. | \$              | cts. |            |    |
| 1886-1887.                   | 183,114                | 78   | 35,707        | 41   |             |      | 21,676          | 57   | 3,249                  | 25   | 3,317              | 16   | 90              | 15   | 247,155    | 32 |
| 1887-1888.                   | 223,360                | 73   | 42,045        | 11   |             |      | 42,072          | 07   | 1,367                  | 05   | 7,212              | 02   | 372             | 79   | 310,497    | 58 |
| 1888-1889.                   | 243,046                | 84   | 52,354        | 91   | 26,146      | 13   | 46,072          | 07   | 739                    | 25   | 6,543              | 53   | 1,075           | 36   | 371,478    | 12 |
| 1889-1890.                   | 224,770                | 16   | 45,188        | 57   | 5,017       | 44   | 29,921          | 61   | 958                    | 75   | 8,866              | 39   | 291             | 63   | 314,984    | 55 |
| 1890-1891.                   | 268,751                | 35   | 38,826        | 33   | 3,385       | 60   | 54,229          | 69   | 1,595                  | 02   | 10,866             | 65   | 627             | 81   | 380,282    | 45 |
| 1891-1892.                   | 327,106                | 07   | 136,131       | 80   | 5,957       | 65   | 42,360          | 80   | 788                    | 92   | 9,392              | 11   | 532             | 14   | 532,179    | 49 |
| 1892-1893.                   | 303,550                | 86   | 82,615        | 22   | 5,866       | 65   | 33,776          | 90   | 777                    | 00   | 10,759             | 38   | 1,331           | 96   | 488,668    | 53 |
| 1893-1894.                   | 214,540                | 40   | 47,574        | 11   | 2,339       | 16   | 22,318          | 15   | 864                    | 15   | 10,358             | 02   | 1,492           | 24   | 299,375    | 38 |
| 1894-1895.                   | 171,085                | 48   | 47,065        | 10   | 2,752       | 56   | 27,645          | 97   | 693                    | 85   | 9,811              | 77   | 875             | 36   | 255,530    | 09 |
| 1895-1896.                   | 174,509                | 38   | 56,584        | 32   | 8,748       | 05   | 17,550          | 28   | 502                    | 00   | 8,737              | 87   | 1,920           | 66   | 268,552    | 56 |
| (Total, 10 yrs. to 1895-6).  | 2,343,835              | 95   | 584,092       | 91   | 62,212      | 80   | 322,791         | 97   | 11,435                 | 24   | 85,765             | 90   | 9,069           | 90   | 3,419,804  | 67 |
| 1896-1897.                   | 187,424                | 19   | 24,292        | 43   | 9,887       | 13   | 9,831           | 27   | 1,316                  | 00   | 8,997              | 24   | 2,683           | 05   | 244,431    | 31 |
| 1897-1898.                   | 780,313                | 10   | 52,410        | 82   | 12,351      | 71   | 22,537          | 17   | 529                    | 05   | 14,263             | 50   | 269             | 92   | 1,082,666  | 28 |
| 1898-1899.                   | 1,563,620              | 74   | 41,249        | 77   | 12,388      | 69   | 12,319          | 65   | 2,801                  | 63   | 19,229             | 73   | 2,630           | 91   | 1,653,651  | 52 |
| 1899-1900.                   | 1,410,883              | 48   | 220,874       | 78   | 15,271      | 81   | 11,043          | 53   | 1,452                  | 92   | 21,751             | 90   | 3,654           | 00   | 1,684,942  | 45 |
| 1900-1901.                   | 1,333,197              | 07   | 48,049        | 83   | 15,711      | 63   | 14,004          | 47   | 1,977                  | 96   | 33,979             | 77   | 1,587           | 57   | 1,649,108  | 30 |
| 1901-1902.                   | 1,254,333              | 56   | 193,410       | 75   | 29,263      | 06   | 16,967          | 36   | 1,935                  | 51   | 50,854             | 99   | 3,900           | 62   | 1,541,715  | 95 |
| 1902-1903.                   | 1,716,597              | 20   | 392,206       | 93   | 28,789      | 97   | 17,612          | 79   | 5,220                  | 88   | 81,404             | 18   | 2,230           | 26   | 2,244,062  | 21 |
| 1903-1904.                   | 1,473,106              | 33   | 233,769       | 62   | 26,122      | 30   | 39,491          | 31   | 5,911                  | 92   | 169,233            | 73   | 3,402           | 94   | 1,887,941  | 18 |
| 1904-1905.                   | 1,314,185              | 40   | 332,914       | 48   | 16,471      | 34   | 10,346          | 90   | 10,018                 | 49   | 123,082            | 86   | 4,258           | 14   | 1,811,577  | 61 |
| 1905-1906.                   | 1,701,580              | 71   | 668,960       | 79   | 12,577      | 29   | 10,803          | 17   | 3,304                  | 77   | 180,310            | 73   | 8,496           | 09   | 2,526,123  | 55 |
| (Total, 10 yrs. to 1905-6).  | 13,139,491             | 78   | 2,148,140     | 20   | 169,864     | 96   | 156,680         | 65   | 31,488                 | 64   | 613,099            | 63   | 33,104          | 50   | 16,325,320 | 36 |
| 1906-1907 (9 months).        | 1,478,749              | 51   | 724,353       | 73   | 10,850      | 06   | 6,663           | 90   | 21                     | 00   | 46,124             | 20   | 11,785          | 81   | 2,278,548  | 21 |
| 1907-1908.                   | 1,998,219              | 92   | 708,045       | 83   | 12,899      | 84   | 8,674           | 95   | 1,650                  | 00   | 2,256              | 65   | 20,069          | 03   | 2,751,816  | 22 |
| 1908-1909.                   | 2,254,283              | 98   | 687,422       | 74   | 53,599      | 86   | 205,749         | 96   | 281                    | 90   | 1,352              | 13   | 26,224          | 29   | 3,228,304  | 36 |
| (Total, 2 yrs. and 9 months) | 5,731,253              | 41   | 2,119,822     | 30   | 77,340      | 76   | 221,088         | 81   | 1,952                  | 00   | 49,732             | 98   | 58,079          | 13   | 8,259,269  | 39 |
| Grand total.                 | 21,215,031             | 14   | 4,852,655     | 41   | 309,418     | 52   | 700,561         | 43   | 47,875                 | 88   | 778,598            | 51   | 100,253         | 53   | 28,004,394 | 42 |



SESSIONAL PAPER No. 25

STATEMENT showing Receipts on Account of Dominion Lands from July 1, 1872, to March 31, 1909.

| Fiscal Year.             | Homestead Fees. |      | Pre-emption Fees. |      | Improvements. |            | SALES.       |              | Map Sales, Office and Registration Fees, &c. |      | Dominion Lands Surveyors Examination Fees. |      | Rentals, Survey Fees, Miscellaneons, including Trust Account. |      | Purchased Homestead, Inspection, Cancellation and Sundry Fees. |      | Timber Dues. |            |  |
|--------------------------|-----------------|------|-------------------|------|---------------|------------|--------------|--------------|--|------|--|------|---|------|--|------|--------------|------------|--|
|                          | \$              | cts. | \$                | cts. | \$            | cts.       | Cash.        | scrip.       | \$   | cts. | \$   | cts. | \$  | cts. | \$   | cts. | \$           | cts.       |  |
| 1872-73.                 | 6,360 00        |      |                   |      |               |            | 19,170 20    |              |  |      |  |      |   |      |  |      | 109 25       |            |  |
| 1873-74.                 | 7,310 00        |      |                   |      |               |            | 19,834 75    |              |  |      |  |      |   |      |  |      | 2,710 55     |            |  |
| 1874-75.                 | 11,510 00       |      |                   |      |               |            | 13,666 90    |              | 129 90                                       |      |  |      |   |      |  |      | 2,335 25     |            |  |
| 1875-76.                 | 4,680 00        |      |                   |      |               |            | 3,478 94     | 320 00       |  |      |  |      |   |      |  |      | 387 00       |            |  |
| 1876-77.                 | 2,250 00        |      |                   |      |               |            | 1,085 86     | 136,955 16   | 4 60   |      |  |      |   |      |  |      | 320 00       |            |  |
| 1877-78.                 | 14,540 00       |      |                   |      |               |            | 2,794 86     | 120,159 54   |  |      |  |      |   |      |  |      | 1,620 00     |            |  |
| 1878-79.                 | 17,890 00       |      |                   |      |               |            | 4,998 39     | 210,904 84   | 81 00  |      |  |      |   |      |  |      | 325 00       |            |  |
| 1879-80.                 | 41,255 00       |      |                   |      |               |            | 45,708 97    | 81,685 86    | 245 40                                       |      |  |      |   |      |  |      | 1,780 00     |            |  |
| 1880-81.                 | 20,450 00       |      |                   |      |               | 10,241 43  | 71,170 17    | 70,828 30    | 985 40                                       |      |  |      |   |      |  |      | 25,121 46    |            |  |
| 1881-82.                 | 54,155 00       |      |                   |      |               | 39,843 90  | 1,240,328 27 | 50,500 84    | 3,026 45                                     |      |  |      |   |      |  |      | 32,028 31    |            |  |
| 1882-83.                 | 73,015 00       |      |                   |      |               | 39,843 90  | 516,692 21   | 33,638 49    | 3,109 50                                     |      |  |      |   |      |  |      | 58,753 14    |            |  |
| 1883-84.                 | 41,580 00       |      |                   |      |               | 28,810 00  | 424,863 36   | 40,919 67    | 1,289 55                                     |      |  |      |   |      |  |      | 140,066 46   |            |  |
| 1884-85.                 | 25,645 00       |      |                   |      |               | 17,100 00  | 199,275 32   | 45,875 60    | 1,621 82                                     |      |  |      |   |      |  |      | 90,240 00    |            |  |
| 1885-86.                 | 26,110 00       |      |                   |      |               | 14,371 00  | 76,140 41    | 214,657 97   | 1,339 34                                     |      |  |      |   |      |  |      | 65,111 74    |            |  |
| 1886-87.                 | 19,614 00       |      |                   |      |               | 6,887 93   | 48,175 76    | 337,640 19   | 1,171 39                                     |      |  |      |   |      |  |      | 7,778 40     |            |  |
| 1887-88.                 | 23,691 00       |      |                   |      |               | 4,830 00   | 52,238 36    | 313,322 67   | 1,660 75                                     |      |  |      |   |      |  |      | 94,864 55    |            |  |
| 1888-89.                 | 39,460 00       |      |                   |      |               | 10,350 00  | 57,513 16    | 318,238 57   | 1,410 16                                     |      |  |      |   |      |  |      | 90,240 00    |            |  |
| 1889-90.                 | 35,920 00       |      |                   |      |               | 8,580 00   | 51,896 85    | 228,744 47   | 2,069 07                                     |      |  |      |   |      |  |      | 20,402 50    |            |  |
| 1890-91.                 | 29,164 10       |      |                   |      |               |            | 91,664 98    | 171,425 14   | 1,854 78                                     |      |  |      |   |      |  |      | 84,642 95    |            |  |
| 1891-92.                 | 46,994 00       |      |                   |      |               |            | 108,901 01   | 97,822 41    | 2,147 31                                     |      |  |      |   |      |  |      | 20,232 50    |            |  |
| 1892-93.                 | 36,462 26       |      |                   |      |               |            | 93,671 67    | 77,231 18    | 975 20                                       |      |  |      |   |      |  |      | 14,712 50    |            |  |
| 1893-94.                 | 29,664 88       |      |                   |      |               |            | 53,251 71    | 27,840 96    | 973 11                                       |      |  |      |   |      |  |      | 23,104 50    |            |  |
| 1894-95.                 | 35,920 00       |      |                   |      |               |            | 37,293 71    | 33,269 62    | 695 99                                       |      |  |      |   |      |  |      | 106,461 35   |            |  |
| 1895-96.                 | 31,278 00       |      |                   |      |               |            | 46,373 98    | 46,329 65    | 610 78                                       |      |  |      |   |      |  |      | 105,865 24   |            |  |
| 1896-97.                 | 21,179 00       |      |                   |      |               |            | 49,335 53    | 80,178 64    | 795 05                                       |      |  |      |   |      |  |      | 81,290 51    |            |  |
| 1897-98.                 | 34,780 00       |      |                   |      |               |            | 89,178 64    | 28,918 14    | 1,987 40                                     |      |  |      |   |      |  |      | 74,079 20    |            |  |
| 1898-99.                 | 58,235 00       |      |                   |      |               |            | 116,598 35   | 21,307 58    | 1,262 05                                     |      |  |      |   |      |  |      | 6,566 90     |            |  |
| 1899-1900.               | 72,690 00       |      |                   |      |               |            | 103,247 58   | 88,756 22    | 1,238 85                                     |      |  |      |   |      |  |      | 21,679 31    |            |  |
| 1900-1901.               | 79,910 00       |      |                   |      |               |            | 40,369 93    | 326,270 03   | 3,874 14                                     |      |  |      |   |      |  |      | 6,810 50     |            |  |
| 1901-1902.               | 144,425 00      |      |                   |      |               |            | 66,950 21    | 169,767 13   | 5,792 96                                     |      |  |      |   |      |  |      | 19,421 98    |            |  |
| 1902-1903.               | 520,469 65      |      |                   |      |               |            | 155,597 59   | 158,452 66   | 5,911 96                                     |      |  |      |   |      |  |      | 10,042 90    |            |  |
| 1903-1904.               | 255,772 36      |      |                   |      |               |            | 196,750 15   | 188,424 22   | 5,549 13                                     |      |  |      |   |      |  |      | 13,549 50    |            |  |
| 1904-1905.               | 304,806 25      |      |                   |      |               |            | 154,128 04   | 188,424 22   | 1,262 05                                     |      |  |      |   |      |  |      | 14,967 00    |            |  |
| 1905-1906.               | 417,834 25      |      |                   |      |               |            | 442,588 69   | 7,654 57     | 6,042 34                                     |      |  |      |   |      |  |      | 563 00       |            |  |
| 1906-1907 (nine months). | 215,449 55      |      |                   |      |               |            | 391,117 12   | 11,849 89    | 5,449 06                                     |      |  |      |   |      |  |      | 1,083 50     |            |  |
| 1907-1908.               | 301,693 73      |      |                   |      |               |            | 636,303 03   | 92,311 24    | 7,727 29                                     |      |  |      |   |      |  |      | 1,283 50     |            |  |
| 1908-1909.               | 389,939 00      |      |                   |      |               |            | 451,442 28   | 20,136 27    | 7,296 55                                     |      |  |      |   |      |  |      | 269,837 52   |            |  |
| Total.                   | 3,280,310 77    |      |                   |      |               | 348,291 16 | 6,790,100 94 | 3,739,122 96 | 83,265 91                                    |      |  |      |   |      |  |      | 4,819,609 87 |            |  |
|                          |                 |      |                   |      |               |            |              |              |  |      |  |      |   |      |  |      |              | 233,368 54 |  |

STATEMENT showing Receipts on Account of Dominion Lands from July 1, 1872, to March 31, 1909—Concluded.

| Fiscal Year.             | GRAZING LANDS. |      | HAY, COAL, MINING, STONE QUARRIES, & EXPORT TAX ON GOLD, &C. |      | Rocky Mountains Park of Canada. |      | COLONIZATION LANDS. |      | Gross Revenue. | Refunds.   | Net Revenue.  |
|--------------------------|----------------|------|--|------|---------------------------------|------|---------------------|------|----------------|------------|---------------|
|                          | Scrip, &c.     |      | Cash.  |      | Scrip.                          |      | Cash.               |      |                |            |               |
|                          | \$             | cts. | \$   | cts. | \$                              | cts. | \$                  | cts. |                |            |               |
| 1872-73.                 |                |      |  |      |                                 |      |                     |      | 26,239 45      |            | 26,239 45     |
| 1873-74.                 |                |      |  |      |                                 |      |                     |      | 29,980 80      |            | 29,980 80     |
| 1874-75.                 |                |      |  |      |                                 |      |                     |      | 27,641 15      |            | 27,641 15     |
| 1875-76.                 |                |      |  |      |                                 |      |                     |      | 8,865 94       |            | 8,865 94      |
| 1876-77.                 |                |      |  |      |                                 |      |                     |      | 140,755 02     |            | 140,755 02    |
| 1877-78.                 |                |      |  |      |                                 |      |                     |      | 139,584 40     |            | 139,584 40    |
| 1878-79.                 |                |      |  |      |                                 |      |                     |      | 254,732 93     |            | 254,732 93    |
| 1879-80.                 |                |      |  |      |                                 |      |                     |      | 206,801 37     | 4,636 08   | 202,165 29    |
| 1880-81.                 |                |      |  |      |                                 |      |                     |      | 206,990 51     | 5,038 22   | 201,952 32    |
| 1881-82.                 |                |      |  |      |                                 |      |                     |      | 1,805,734 87   | 10,687 55  | 1,795,047 32  |
| 1882-83.                 |                |      |  |      |                                 |      |                     |      | 248,492 17     | 8,746 05   | 239,746 12    |
| 1883-84.                 |                |      |  |      |                                 |      |                     |      | 253,713 40     | 9,220 50   | 244,492 90    |
| 1884-85.                 |                |      |  |      |                                 |      |                     |      | 1,001,776 67   | 12,070 85  | 989,705 82    |
| 1885-86.                 |                |      |  |      |                                 |      |                     |      | 457,973 95     | 63,389 12  | 394,584 83    |
| 1886-87.                 |                |      |  |      |                                 |      |                     |      | 588,532 80     | 19,513 16  | 569,019 64    |
| 1887-88.                 |                |      |  |      |                                 |      |                     |      | 569,986 68     | 6,277 66   | 563,709 02    |
| 1888-89.                 |                |      |  |      |                                 |      |                     |      | 594,088 01     | 5,226 23   | 588,861 81    |
| 1889-90.                 |                |      |  |      |                                 |      |                     |      | 482,336 26     | 8,209 71   | 474,126 55    |
| 1890-91.                 |                |      |  |      |                                 |      |                     |      | 460,990 76     | 7,195 27   | 453,795 49    |
| 1891-92.                 |                |      |  |      |                                 |      |                     |      | 1,521,151 08   | 15,291 30  | 1,505,859 78  |
| 1892-93.                 |                |      |  |      |                                 |      |                     |      | 392,324 43     | 18,314 97  | 374,009 46    |
| 1893-94.                 |                |      |  |      |                                 |      |                     |      | 290,069 12     | 4,544 01   | 285,525 11    |
| 1894-95.                 |                |      |  |      |                                 |      |                     |      | 292,983 10     | 4,365 99   | 288,617 11    |
| 1895-96.                 |                |      |  |      |                                 |      |                     |      | 227,694 93     | 8,368 79   | 219,326 14    |
| 1896-97.                 |                |      |  |      |                                 |      |                     |      | 296,833 57     | 13,010 54  | 283,823 03    |
| 1897-98.                 |                |      |  |      |                                 |      |                     |      | 1,009,741 63   | 4,678 55   | 1,005,063 08  |
| 1898-99.                 |                |      |  |      |                                 |      |                     |      | 1,584,328 32   | 32,296 30  | 1,552,032 02  |
| 1900-1901.               |                |      |  |      |                                 |      |                     |      | 1,480,680 72   | 23,062 98  | 1,457,617 74  |
| 1901-1902.               |                |      |  |      |                                 |      |                     |      | 1,874,159 09   | 18,368 85  | 1,855,790 24  |
| 1902-1903.               |                |      |  |      |                                 |      |                     |      | 1,432,679 25   | 27,165 55  | 1,405,513 70  |
| 1903-1904.               |                |      |  |      |                                 |      |                     |      | 1,890,886 83   | 24,519 84  | 1,866,366 99  |
| 1904-1905.               |                |      |  |      |                                 |      |                     |      | 1,681,824 70   | 36,721 75  | 1,645,102 95  |
| 1905-1906.               |                |      |  |      |                                 |      |                     |      | 1,339,382 35   | 25,786 90  | 1,313,595 45  |
| 1906-1907 (nine months). |                |      |  |      |                                 |      |                     |      | 1,709,315 28   | 33,418 36  | 1,675,896 92  |
| 1907-1908*               |                |      |  |      |                                 |      |                     |      | 1,490,503 31   | 35,117 48  | 1,455,385 83  |
| 1908-1909.               |                |      |  |      |                                 |      |                     |      | 2,094,579 17   | 115,080 01 | 1,979,499 13  |
|                          |                |      |  |      |                                 |      |                     |      | 2,277,678 09   | 102,463 78 | 2,175,214 31  |
|                          |                |      |  |      |                                 |      |                     |      | 30,987,077 13  | 701,815 80 | 29,285,261 24 |
|                          |                |      |  |      |                                 |      |                     |      | 857,461 08     | 30,460 50  | 826,999 58    |

\* Including scrip.

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STATEMENT of Rocky Mountains Park Revenue for Fiscal Year ended March 31, 1909, as compared with Revenue for previous year.

| Particulars.                             | Fiscal year | Fiscal year | Increase. | Decrease. | Net Increase. |
|--|-------------|-------------|-----------|-----------|---------------|
|  | 1908-9.     | 1907-8.     |           |           |               |
|  | \$ cts.     | \$ cts.     | \$ cts.   | \$ cts.   | \$ cts.       |
| Rent.....                                | 4,567 82    | 5,351 49    |           | 783 67    |               |
| Timber dues.....                         | 1,862 14    | 1,341 39    | 520 75    |           |               |
| Water rates.....                         | 410 00      | 208 44      | 201 56    |           |               |
| Transfer fees.....                       | 32 00       | 46 00       |           | 14 00     |               |
| Cave and basin (bathing tickets).....    | 2,801 50    | 3,277 00    |           | 475 50    |               |
| Quarry permits.....                      | 236 73      | 488 00      |           | 251 27    |               |
| Dog licenses.....                        | 372 79      | 181 50      | 191 20    |           |               |
| Livery licenses.....                     | 394 00      | 567 00      |           | 173 00    |               |
| Pool, billiard and bowling licenses..... | 150 00      | 160 00      |           | 10 00     |               |
| Boat licenses.....                       | 59 00       | 25 00       | 64 00     |           |               |
| Butcher licenses.....                    | 50 00       | 40 00       | 10 00     |           |               |
| Coal lands.....                          | 16,252 44   | 11,866 80   | 4,385 64  |           |               |
| Grazing lands.....                       | 180 00      | 230 00      |           | 50 00     |               |
| Hot Springs (bathing tickets).....       | 2,988 00    | 3,108 50    |           | 120 50    |               |
| Telephone rent.....                      | 694 00      | 242 50      | 451 50    |           |               |
| Fines.....                               | 36 00       | 11 00       | 25 00     |           |               |
| Sale of lumber.....                      |             | 20 00       |           | 20 00     |               |
| Pedlars' licenses.....                   | 34 00       | 36 00       | 18 00     |           |               |
| Camping permits.....                     | 23 00       | 22 00       | 1 00      |           |               |
| Lime permits.....                        | 4 75        |             | 4 75      |           |               |
| Miscellaneous.....                       | 123 12      | 10 25       | 112 87    |           |               |
|  | 31,321 20   | 27,232 87   | 5,986 27  | 1,897 94  | 4,088 33      |

REVENUE.

The gross cash revenue of the department during the year was \$3,228,904.96, which shows an increase of over \$477,088.74 as compared with the previous year. The net increase in the cash revenue of the department on account of Dominion Lands was \$269,634.73. This increase is largely attributable to the amount received on account of pre-emption fees and the increase in the number of homestead entries granted during the year. It may be pointed out that it is not the policy of the department to dispose of land by sale, and while the statement shows a very large revenue derived under that head it should be explained that this amount is made up largely of moneys received on account of the sale of irrigation, coal, and purchased homestead lands, as provided under the law in that behalf.

The following is a comparative statement of the homestead entries and sales which have been made at the several agencies of the department during the fiscal years ending March 31, 1908, and March 31, 1909, respectively.

|                 | Fiscal year ending<br>March 31, 1908. |           | Fiscal year ending<br>March 31, 1909. |           |
|-----------------|---------------------------------------|-----------|---------------------------------------|-----------|
|                 | No. of<br>Entries.                    | Acres.    | No. of<br>Entries.                    | Acres.    |
| Homesteads..... | 30,424                                | 4,867,840 | 39,081                                | 6,252,960 |
| Sales.....      |                                       | 179,894   |                                       | 191,315   |

The following statement shows the number of homestead entries reported in each year since 1874.

| Departmental year ended          | Number of<br>Entries. |
|----------------------------------|-----------------------|
| October 31, 1874                 | 1,376                 |
| " 31, 1875                       | 499                   |
| " 31, 1876                       | 347                   |
| " 31, 1877                       | 845                   |
| " 31, 1878                       | 1,788                 |
| " 31, 1879                       | 4,068                 |
| " 31, 1880                       | 2,074                 |
| " 31, 1881                       | 2,753                 |
| " 31, 1882                       | 7,483                 |
| " 31, 1883                       | 6,063                 |
| " 31, 1884                       | 3,753                 |
| " 31, 1885                       | 1,858                 |
| " 31, 1886                       | 2,657                 |
| " 31, 1887                       | 2,036                 |
| " 31, 1888                       | 2,655                 |
| " 31, 1889                       | 4,416                 |
| " 31, 1890                       | 2,955                 |
| " 31, 1891                       | 3,523                 |
| " 31, 1892                       | 4,840                 |
| " 31, 1893                       | 4,067                 |
| " 31, 1894                       | 3,209                 |
| December 31, 1895                | 2,394                 |
| " 31, 1896                       | 1,857                 |
| " 31, 1897                       | 2,384                 |
| " 31, 1898                       | 4,848                 |
| " 31, 1899                       | 6,689                 |
| June 30, 1900                    | 7,426                 |
| " 30, 1901                       | 8,167                 |
| " 30, 1902                       | 14,673                |
| " 30, 1903                       | 31,383                |
| " 30, 1904                       | 26,073                |
| " 30, 1905                       | 30,819                |
| " 30, 1906                       | 41,869                |
| Nine months ended March 31, 1907 | 21,647                |
| Year ended March 31, 1908        | 30,424                |
| " " " 31, 1909                   | 39,081                |

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STATEMENT showing the number of Homestead Entries made during the fiscal year ended March 31, 1909, and the Nationality of the Homesteaders, as reported by the several Agencies of the Department in Manitoba, Saskatchewan, Alberta and British Columbia.

| Nationalities.   | No. of Entries. |
|--|-----------------|
| Canadians from Ontario. . . . .                          | 4,038           |
| “ “ Quebec. . . . .                                      | 790             |
| “ “ Nova Scotia. . . . .                                 | 212             |
| “ “ New Brunswick. . . . .                               | 91              |
| “ “ Prince Edward Island. . . . .                        | 93              |
| “ “ Manitoba. . . . .                                    | 1,494           |
| “ “ Saskatchewan. . . . .                                | 2,372           |
| “ “ Alberta. . . . .                                     | 1,048           |
| “ “ British Columbia. . . . .                            | 131             |
| Persons who had previous entry. . . . .                  | 3,267           |
| Newfoundlanders. . . . .                                 | 5               |
| Canadians returning from the United States. . . . .      | 693             |
| Americans. . . . .                                       | 9,829           |
| English. . . . .   | 5,649           |
| Scotch. . . . .  | 1,310           |
| Irish. . . . .   | 506             |
| French. . . . .  | 487             |
| Belgians. . . . .  | 167             |
| Swiss. . . . .   | 49              |
| Italians. . . . .  | 26              |
| Roumanians. . . . .                                      | 123             |
| Syrians. . . . .   | 28              |
| Germans. . . . .   | 650             |
| Austro-Hungarians. . . . .                               | 3,342           |
| Hollanders. . . . .                                      | 92              |
| Danes (other than Icelanders). . . . .                   | 116             |
| Icelanders. . . . .                                      | 231             |
| Swedes. . . . .  | 596             |
| Norwegians. . . . .                                      | 656             |
| Russians (other than Menmonites and Doukhobors). . . . . | 947             |
| Doukhobors. . . . .                                      | 4               |
| Chinese. . . . .   | 6               |
| Japanese. . . . .  | 4               |
| Persians. . . . .  | 4               |
| Australians. . . . .                                     | 13              |
| Hindoos. . . . .   | 2               |
| Spaniards. . . . .                                       | 3               |
| Bulgarians. . . . .                                      | 5               |
| Servians. . . . .  | 2               |
| Total. . . . .   | <hr/> 39,081    |

Representing 93,852 souls

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STATEMENT showing the number of Homestead Entries made during the fiscal year ended March 31, 1909, by persons coming from the various States and Territories of the American Union.

| States.                         | No. of Entries. |
|---------------------------------|-----------------|
| Alabama. . . . .                | 1               |
| Alaska 12, Arizona 4. . . . .   | 16              |
| Arkansas. . . . .               | 8               |
| California. . . . .             | 79              |
| Carolina, North. . . . .        | 9               |
| Colorado. . . . .               | 25              |
| Columbia, District of . . . . . | 2               |
| Connecticut. . . . .            | 10              |
| Dakota, North. . . . .          | 3,921           |
| Dakota, South. . . . .          | 415             |
| Delaware. . . . .               | 1               |
| Florida. . . . .                | 4               |
| Idaho. . . . .                  | 115             |
| Illinois. . . . .               | 327             |
| Indiana. . . . .                | 123             |
| Indian Territory. . . . .       | 2               |
| Iowa. . . . .                   | 440             |
| Kansas. . . . .                 | 146             |
| Kentucky. . . . .               | 16              |
| Louisiana. . . . .              | 3               |
| Maine. . . . .                  | 30              |
| Maryland. . . . .               | 8               |
| Massachusetts. . . . .          | 91              |
| Michigan. . . . .               | 497             |
| Minnesota. . . . .              | 1,826           |
| Missouri. . . . .               | 144             |
| Montana. . . . .                | 263             |
| Nebraska. . . . .               | 198             |
| New Hampshire. . . . .          | 10              |
| New Jersey. . . . .             | 5               |
| New Mexico. . . . .             | 5               |
| New York. . . . .               | 171             |
| Ohio. . . . .                   | 121             |
| Oklahoma. . . . .               | 96              |
| Oregon. . . . .                 | 118             |
| Pennsylvania. . . . .           | 108             |
| Rhode Island. . . . .           | 7               |
| Tennessee. . . . .              | 12              |
| Texas. . . . .                  | 20              |
| Utah. . . . .                   | 76              |
| Vermont. . . . .                | 9               |

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| States.                 | No. of Entries. |
|-------------------------|-----------------|
| Washington. . . . .     | 462             |
| Virginia, West. . . . . | 19              |
| Wisconsin. . . . .      | 536             |
| Wyoming. . . . .        | 27              |
|                         | 10,522          |

STATEMENT showing the number of Letters-Patent issued by the Department of the Interior in each year since 1874.

| Period.                                   | Number issued. |
|---|----------------|
| Year ended October 31, 1874. . . . .      | 536            |
| “ “ 31, 1875. . . . .                     | 492            |
| “ “ 31, 1876. . . . .                     | 375            |
| “ “ 31, 1877. . . . .                     | 2,156          |
| “ “ 31, 1878. . . . .                     | 2,597          |
| “ “ 31, 1879. . . . .                     | 2,194          |
| “ “ 31, 1880. . . . .                     | 1,704          |
| “ “ 31, 1881. . . . .                     | 1,768          |
| “ “ 31, 1882. . . . .                     | 2,766          |
| “ “ 31, 1883. . . . .                     | 3,591          |
| “ “ 31, 1884. . . . .                     | 3,837          |
| “ “ 31, 1885. . . . .                     | 3,257          |
| “ “ 31, 1886. . . . .                     | 4,570          |
| “ “ 31, 1887. . . . .                     | 4,599          |
| “ “ 31, 1888. . . . .                     | 3,275          |
| “ “ 31, 1889. . . . .                     | 3,282          |
| “ “ 31, 1890. . . . .                     | 3,273          |
| “ “ 31, 1891. . . . .                     | 2,449          |
| “ “ 31, 1892. . . . .                     | 2,955          |
| “ “ 31, 1893. . . . .                     | 2,936          |
| “ “ 31, 1894. . . . .                     | 2,553          |
| “ December 31, 1894. . . . .              | 2,682          |
| “ “ 31, 1895. . . . .                     | 2,118          |
| “ “ 31, 1896. . . . .                     | 2,665          |
| “ “ 31, 1897. . . . .                     | 2,972          |
| “ “ 31, 1898. . . . .                     | 3,037          |
| “ “ 31, 1899. . . . .                     | 3,904          |
| Six months ended June 30, 1900. . . . .   | 1,970          |
| Year “ 30, 1901. . . . .                  | 6,461          |
| “ “ 30, 1902. . . . .                     | 8,768          |
| “ “ 30, 1903. . . . .                     | 7,349          |
| “ “ 30, 1904. . . . .                     | 6,890          |
| “ “ 30, 1905. . . . .                     | 8,798          |
| “ “ 30, 1906. . . . .                     | 12,370         |
| Nine months ended March 31, 1907. . . . . | 10,596         |
| Year ended March 31, 1908. . . . .        | 18,690         |
| “ “ 31, 1909. . . . .                     | 22,431         |





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## CORRESPONDENCE.

The following statement shows the number of letters received and sent by the department in each year since its establishment.

| Departmental Year ended October 31.               | Letters Received. | Letters Sent. | Total.    |
|---|-------------------|---------------|-----------|
| 1874.....   | 3,482             | 4,120         | 7,602     |
| 1875.....   | 1,974             | 2,189         | 4,163     |
| 1876.....   | 2,256             | 3,097         | 5,353     |
| 1877.....   | 3,137             | 3,677         | 6,814     |
| 1878.....   | 4,642             | 6,009         | 10,651    |
| 1879.....   | 5,586             | 6,179         | 11,765    |
| 1880.....   | 8,222             | 9,910         | 18,162    |
| 1881.....   | 13,605            | 15,829        | 29,434    |
| 1882.....   | 25,500            | 30,300        | 55,800    |
| 1883.....   | 27,180            | 33,500        | 60,680    |
| 1884.....   | 27,525            | 33,386        | 60,911    |
| 1885.....   | 33,970            | 43,997        | 77,967    |
| 1886.....   | 60,964            | 67,973        | 128,937   |
| 1887.....   | 47,845            | 60,890        | 108,735   |
| 1888.....   | 43,407            | 52,298        | 95,705    |
| 1889.....   | 48,316            | 50,500        | 98,816    |
| 1890.....   | 36,200            | 36,008        | 72,208    |
| 1891.....   | 58,000            | 36,267        | 74,267    |
| 1892.....   | 41,990            | 42,203        | 84,193    |
| 1893.....   | 50,794            | 48,145        | 98,939    |
| 1894.....   | 48,619            | 50,840        | 99,459    |
| 1895.....   | 49,991            | 45,898        | 95,889    |
| 1896.....   | 47,591            | 44,238        | 91,739    |
| 1897.....   | 65,714            | 64,147        | 129,861   |
| 1898.....   | 88,913            | 87,845        | 176,758   |
| 1899.....   | 95,023            | 91,876        | 186,899   |
| 1900.....   | 121,219           | 133,177       | 254,396   |
| 1901.....   | 144,978           | 136,348       | 281,326   |
| 1902.....   | 167,200           | 185,548       | 352,748   |
| 1903 (From June 30, 1902, to July 1, 1903).....   | 185,582           | 223,463       | 409,045   |
| 1904 (From June 30, 1903, to July 1, 1904).....   | 222,316           | 274,675       | 496,991   |
| 1905 (From June 30, 1904, to July 1, 1905).....   | 245,470           | 302,723       | 548,193   |
| 1906 (From June 30, 1905, to July 1, 1906).....   | 407,794           | 529,465       | 937,259   |
| 1907 (From June 30, 1906, to April 1, 1907).....  | 372,231           | 620,968       | 993,199   |
| 1908 (From March 31, 1907, to April 1, 1908)..... | 543,647           | 1,106,772     | 1,650,419 |
| 1909 (From March 31, 1908, to April 1, 1909)..... | 721,217           | 1,114,380     | 1,835,597 |

The number of registered letters during the departmental year ending March 31, 1909, was: received, 14,504; sent, 42,790.

## STATEMENT of Land Sales by Railway Companies having Government

| YEAR.                             | HUDSON'S BAY COMPANY. |           | CANADIAN PACIFIC RAILWAY COMPANY. |            | MANITOBA SOUTH-WESTERN COLONIZATION RAILWAY COMPANY. |           | QU'APPELLE, LONG LAKE AND SASKATCHEWAN RAILROAD AND STEAM-BOAT COMPANY. |           |
|-----------------------------------|-----------------------|-----------|-----------------------------------|------------|--|-----------|---|-----------|
|                                   | Acres.                | Amount.   | Acres.                            | Amount.    | Acres.   | Amount.   | Acres.  | Amount.   |
|                                   |                       | \$        |                                   | \$         |  | \$        |   | \$        |
| 1893.....                         |                       |           | 93,184                            | 295,288    | 14,164   | 57,559    | 1,603   | .....     |
| 1894.....                         | 7,526                 | 48,225    | 43,155                            | 131,628    | 6,312  | 28,003    | 640   | .....     |
| 1895.....                         | 4,431                 | 23,209    | 55,453                            | 176,950    | 5,623  | 22,330    | 2,391   | .....     |
| 1896.....                         | 9,299                 | 52,410    | 66,624                            | 220,360    | 21,254   | 88,568    | 286   | .....     |
| 1897.....                         | 19,784                | 53,277    | 135,681                           | 431,095    | 63,800   | 234,644   | 2,524   | .....     |
| 1898.....                         | 62,000                | 310,000   | 242,135                           | 757,792    | 106,473  | 363,982   | 22,534  | .....     |
| 1899.....                         | 56,875                | 274,625   | 261,832                           | 814,857    | 58,019   | 199,458   | 61,030  | 178,517   |
| (Fiscal Year) 1900.....           | 70,196                | 352,631   | 379,091                           | 1,152,836  | 133,507  | 437,449   | 18,932  | 53,974    |
| (Fiscal Year) 1901.....           | 82,308                | 399,804   | 339,985                           | 1,046,665  | 59,749   | 214,953   | 22,266  | 74,810    |
| (Fiscal Year) 1902.....           | 269,577               | 1,412,332 | 1,362,478                         | 4,440,500  | 206,411  | 713,365   | 39,835  | 147,365   |
| (Fiscal Year) 1903.....           | 330,046               | 1,939,804 | 2,260,722                         | 8,472,250  | 250,372  | 699,210   | 843,900   | 1,476,900 |
| (Fiscal Year) 1904.....           | 144,857               | 879,910   | 857,474                           | 3,516,864  | 29,522   | 113,303   | .....   | .....     |
| (Fiscal Year) 1905.....           | 139,721               | 865,965   | 411,451                           | 2,045,800  | 80,342   | 296,936   | .....   | .....     |
| (Fiscal Year) 1906.....           | 236,191               | 1,863,375 | 1,012,322                         | 6,015,060  | 83,418   | 360,889   | .....   | .....     |
| (9 months to March 31, 1907)..... | 69,158                | 742,221   | 851,083                           | 4,817,632  | 3,651  | 22,645    | 1,373   | 16,789    |
| (Fiscal Year) 1908.....           | 21,184                | 267,215   | 81,060                            | 727,367    | 31,982   | 153,007   | 5,621   | 68,869    |
| (Fiscal Year) 1909.....           | 25,449                | 288,836   | 29,331                            | 383,390    | 10,396   | 84,845    | 37,662  | 380,371   |
| Total.....                        | 1,539,602             | 9,773,779 | 8,483,061                         | 35,446,334 | 1,164,395  | 4,091,146 | 1,060,577   | 2,397,595 |

\* Returns not received in time for publication.

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Land Grants and by the Hudson's Bay Company.

| CALGARY AND EDMONTON RAILWAY COMPANY. |           | CANADIAN NORTHERN RAILWAY COMPANY. |           | GREAT NORTHWEST CENTRAL RAILWAY COMPANY. |           | TOTALS.    |            | AVERAGE PER ACRE. |
|---------------------------------------|-----------|------------------------------------|-----------|--|-----------|------------|------------|-------------------|
| Acres.                                | Amount.   | Acres.                             | Amount.   | Acres.                                   | Amount.   | Acres.     | Amount.    |                   |
|                                       | \$        |                                    | \$        |  | \$        |            | \$         | ¢                 |
| 11,260                                |           |                                    |           |  |           | 120,211    | 352,847    | 2 93              |
| 11,035                                |           |                                    |           |  |           | 68,668     | 207,856    | 3 02              |
| 46,815                                |           |                                    |           |  |           | 114,713    | 222,489    | 1 94              |
| 10,553                                |           |                                    |           |  |           | 108,016    | 361,338    | 3 34              |
| 9,436                                 |           |                                    |           |  |           | 222,225    | 719,016    | 3 23              |
| 15,481                                |           |                                    |           |  |           | 448,623    | 1,431,774  | 3 18              |
| 24,738                                | 53,335    |                                    |           |  |           | 462,494    | 1,520,792  | 3 28              |
| 46,653                                | 128,256   |                                    |           |  |           | 648,379    | 2,125,146  | 3 27              |
| 116,719                               | 352,037   |                                    |           |  |           | 621,027    | 2,088,269  | 3 36              |
| 323,494                               | 1,033,396 |                                    |           |  |           | 2,201,795  | 7,746,958  | 3 56              |
| 231,800                               | 909,600   | 183,736                            | 631,503   | 128,435                                  | 522,490   | 4,229,011  | 14,651,757 | 3 46              |
| 129,007                               | 563,507   | 64,469                             | 313,575   | 41,858                                   | 177,081   | 1,267,187  | 5,564,240  | 4 39              |
| 105,191                               | 512,898   | 231,797                            | 1,221,469 | 17,593                                   | 103,564   | 990,005    | 5,046,572  | 5 00              |
| 85,784                                | 480,063   | 204,966                            | 1,014,351 | 20,003                                   | 137,503   | 1,642,684  | 9,871,241  | 6 01              |
| 59,515                                | 346,064   | 289,576                            | 1,711,109 | 4,623                                    | 41,470    | 1,277,759  | 7,697,930  | 6 02              |
| 8,606                                 | 75,644    | 193,946                            | 1,746,504 | 1,294                                    | 13,855    | 341,072    | 2,985,992  | 8 78              |
| 6,370                                 | 66,508    | *                                  | *         | 165                                      | 7,935     | 109,373    | 1,211,885  | 11 08             |
| 1,246,457                             | 4,521,308 | 1,171,400                          | 6,638,511 | 213,371                                  | 1,003,898 | 14,873,242 | 63,806,102 |                   |

## LAND SALES.

As regards the sale of land by companies holding grants from the government, it will be observed that there has been a large falling off in the area disposed of, although the average price realized per acre shows a considerable increase as compared with previous years.

I am not aware of any particular reason for this falling off in the area of land sold. However, in view of the ever-increasing demand on the part of settlers with capital for free homestead land, it would have seemed reasonable to suppose that railway companies would have had a corresponding demand for their own lands, as settlers of the type who have been going to the west within recent years, especially from the United States, usually contemplate farming on a large scale. It may be that some of the larger railway companies did not find it to their advantage to place their lands on the market. If such be the case, it is certainly to be regretted in the interests of the country, and especially of the western provinces.

## IMMIGRATION.

COMPARATIVE statement of arrivals at inland and ocean ports during the twelve years ending March 31, 1909.

## ARRIVALS.

| Year.                                     | Great Britain and Ireland. | Other Countries. | United States. | Total.    |
|---|----------------------------|------------------|----------------|-----------|
| 1896-7 .....                              | 11,383                     | 7,921            | 2,412          | 21,716    |
| 1897-8 .....                              | 11,173                     | 11,608           | 9,119          | 31,900    |
| 1898-9 .....                              | 10,660                     | 21,938           | 11,945         | 44,543    |
| 1899-1900 .....                           | * 5,141                    | * 19,211         | * 8,543        | 23,895    |
| 1900 1 .....                              | 11,810                     | 19,352           | 17,987         | 49,149    |
| 1901 2 .....                              | 17,259                     | 23,732           | 26,388         | 67,379    |
| 1902 3 .....                              | 41,792                     | 37,099           | 49,473         | 128,364   |
| 1903-4 .....                              | 59,374                     | 34,785           | 45,171         | 139,330   |
| 1904-5 .....                              | 65,359                     | 37,255           | 43,652         | 146,266   |
| 1905 6 .....                              | 86,796                     | 44,349           | 57,919         | 189,064   |
| 1906-7 (nine months ended March 31) ..... | 55,791                     | 34,217           | 34,659         | 124,667   |
| 1907 8 .....                              | 120,182                    | 83,975           | 58,312         | 262,469   |
| 1908-9 .....                              | 52,901                     | 34,175           | 59,832         | 146,908   |
|   | 549,621                    | 400,617          | 425,412        | 1,366,650 |

The report of the Superintendent of Immigration will be found under Part II. of the general report.

I desire to call special attention to the very complete tables and statements which are again submitted by the superintendent, showing in detail the nationality, occupation and destination of all immigrant arrivals during the period covered by the report. These statistics have been prepared with extreme care and they supply a long-felt want in this relation, as the classification has been so systematized as to readily afford information in connection with any subject dealt with.

\* Arrivals for six months only.

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As would appear from the foregoing table, there has been a large falling off in the total immigration during the past twelve months as compared with the previous year. It should be pointed out, however, that while the number of arrivals was less than that of last year, which was the largest in the history of the country, the average for the previous six years has been well maintained. In this relation it is satisfactory to note also that nearly one-half of the total male population which arrived in Canada last year was composed of farmers and farm labourers.

## BRITISH IMMIGRATION.

The report of the Assistant Superintendent of Emigration at London sets out fully the work that has been conducted in Great Britain and Ireland during the past year, and, although there has been a large falling off in the number of British arrivals, it is gratifying to observe that most of the undesirable elements that have found their way to Canada in previous years have now been almost completely eliminated. This is due largely to the effect of the regulations that came into force in the spring of last year, restricting the emigration to Canada of persons assisted by charitable organizations, and there is no doubt that the results obtained have fully justified the change of policy which was then adopted.

There has been a falling off also in the number of continental arrivals, but this is not surprising, as ever since the termination of the arrangements that had been made for the dissemination of literature throughout various European countries the department has been unable, owing to restrictive laws in force in such countries, to undertake any work of propaganda.

It will be observed with pleasure, however, that there has been a slight increase in the number of arrivals from the United States. In fact, it has been the largest since the movement began in 1897, and it has even exceeded the number of arrivals from Great Britain. The class of settlers coming from the United States is composed chiefly of experienced agriculturists with capital, and the methods followed to engage such movements would appear to have proved so successful that it is proposed to continue the work with increased vigour in future.

## IMMIGRATION FROM THE UNITED STATES.

As regards this class of immigration I wish to call particular attention to the report from Mr. W. J. White, inspector of agencies and press agent, which sums up in very striking form the results of the department's work in the neighbouring republic during the past twelve months. In view of Mr. White's close connection with this unprecedented movement of population ever since its inception in 1897, and his thorough knowledge of conditions which have brought it about, I am sure that his opinion will commend itself to all patriotic Canadians. The arrivals from the United States, as will be observed from the returns, were the largest from any one country during the past year, and of the 60,000 Americans who entered Canada every man, woman and child was possessed, on an average, of \$1,000 in stock, cash and effects. This large addition to our population represents a community composed of the most ex-

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perienced tillers of the soil, and although their traditions may be different from ours, it is gratifying to realize that they come here imbued with such sentiments, as regards the ideals of national life, as readily enable them to appreciate the benefits of Canadian citizenship.

## IMMIGRATION FROM FRANCE AND BELGIUM.

COMPARATIVE Statement of Immigrant Arrivals from France and Belgium during the thirteen years ending March 31, 1909.

| Year.                        | France and Belgium.   |
|------------------------------|-----------------------|
| 1897.. . . . .               | 740                   |
| 1898.. . . . .               | 545                   |
| 1899.. . . . .               | 413                   |
| 1900.. . . . .               | 483                   |
| 1901.. . . . .               | 492                   |
| 1902.. . . . .               | 645                   |
| 1903.. . . . .               | 1,240                 |
| 1904.. . . . .               | (1,534)—2,392—( 858)  |
| 1905.. . . . .               | (1,743)—2,539—( 796)  |
| 1906.. . . . .               | (1,648)—2,754—(1,106) |
| 1907 (9 months).. . . . .    | (1,314)—1,964—( 650)  |
| 1908 (to March 31) . . . . . | (2,671)—3,885—(1,214) |
| 1909 (to March 31).. . . . . | (1,830)—2,658—( 828)  |

It will be seen that there has been a falling off in the number of arrivals from France and Belgium during the past year. As explained by both Mr. Treau de Cœli, the Canadian government agent at Antwerp, and Mr. Paul Wiillard, our agent at Paris, while the total immigration has not come up to the figures of the previous year, those who have come to Canada belong to a better class of emigrants than ever before. However, considering that there has been a falling off in the number of arrivals from the British isles and other European countries, I think that the results of our work in France and Belgium are very satisfactory, especially when one considers that during the seven years ending 1903 there only arrived from those two countries 4,558 immigrants, whereas during the past five years and nine months this number was increased by 16,192. It is not as large, it is true, as could be desired, but it is strong evidence that our work is being prosecuted as energetically as the restrictive laws in force, especially in France, will permit.

## JUVENILE IMMIGRATION.

From the report of Mr. G. Bogue Smart, chief inspector of British immigrant children and receiving homes, it will be seen that there is an increasing demand for juvenile immigrants, from the country districts in Canada. During the year 1907-8 there arrived 2,375 of these children, which was 920 in excess of the previous year, but large as this number was it could only supply less than one-seventh of the total demand on the part of farmers throughout the country.

The arguments put forth by Mr. Smart in favour of this class of immigration are indeed very forceful, supported as they are by the utterances of some of the most

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prominent men in the old country, as well as by the opinion of our own inspectors who keep continually in touch with the thousands of juvenile immigrants who have been placed in homes in Canada.

The system of inspection would appear to be as perfect as can be, and it is satisfactory to note that Mr. J. Obed Smith, the assistant superintendent at London, takes occasion to bear testimony to the excellence of the work conducted by the department in this relation.

## SURVEYS.

During the year 7,412,870 acres of land were subdivided into sections, a somewhat larger amount than in the preceding year. Resurveys were also made of 1,000,960 acres; four hundred and sixty-seven miles of base lines, initial meridians, and various miscellaneous surveys were run.

Seventy parties in all were employed on the survey of Dominion lands, thirty-one of these working on subdivision surveys under contract and thirty-nine being paid by the day. The distribution of these parties by provinces is shown in the following table:—

| Parties.             | In Manitoba. | In Saskatchewan. | In Alberta. | In British Columbia. | In the Territories. | On the Boundary between British Columbia and Yukon Ter. | Partly in one province and partly in another. | Total. |
|----------------------|--------------|------------------|-------------|----------------------|---------------------|---|---|--------|
| Paid by the day..... | 4            | 6                | 15          | 8                    | 2                   | 1   | 3   | 39     |
| Under contract.....  | 7            | 8                | 15          | .....                | .....               | .....   | 1   | 31     |
| Total.....           | 11           | 14               | 30          | 8                    | 2                   | 1   | 4   | 70     |

Three hundred and twelve whole townships and twenty-three fractional townships were completely subdivided, while one hundred and sixty-one townships were partially subdivided.

Resurveys were made, either partial or complete, of one hundred and seventy-one townships. The large amount of resurvey now found necessary is chiefly owing to the fact that in many townships which were surveyed some twenty or thirty years ago the corner monuments, which were not of as durable a nature as those now used, have to a great extent disappeared. In many districts where lands had been surveyed there was but little settlement and the absence of monuments did not attract much attention till the large recent influx of settlers into these townships made it imperative to re-mark the corners, in order to enable them to locate their homesteads.

The base lines necessary as a preliminary for extending the township surveys were surveyed chiefly in the great almost vacant country lying west of Edmonton and east of the Rocky mountains, and comprise portions of the twelfth, thirteenth

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and fifteenth bases. The fifth initial meridian has also been extended northward as far as township 107, about three hundred and thirty miles north of Edmonton, and some twenty miles additional of the sixth meridian was surveyed.

The mileage surveyed during the twelve months was 24,502. This, divided among sixty-seven parties, three parties not being included owing to the nature of their work, gives an average of three hundred and sixty-six miles per party.

A number of townships were surveyed along the line of the Grand Trunk Pacific Railway, between the fifth and sixth initial meridians, extending as far west as the Athabaska river.

A demand having arisen for lands in southern Saskatchewan and Alberta in what was formerly known as the 'semi-arid' district, about one hundred and forty-five townships were subdivided in that region and it is expected that all the townships yet remaining unsurveyed will be subdivided next season. Then practically all the open prairie country will have been surveyed, and the land to be laid out for settlement in the future will be more or less wooded.

Mr. P. A. Carson continued the triangulation of the railway belt in British Columbia, south and west of Golden. Several new stations were fixed as reference points upon which subdivision or other surveys may be based or to which they may be connected.

Mr. A. O. Wheeler, with two sub-parties under Messrs. M. P. Bridgland and H. G. Wheeler, made an examination of vacant lands in the valley of the Columbia river in the railway belt, British Columbia, above and below Revelstoke and above Golden. The object of this examination was to determine the amount of land available for different purposes, such as fruit growing, ordinary farming, grazing or lumbering.

In view of the possible construction at an early date of a railway to Hudson Bay, it was deemed advisable to lay out into town lots the land surrounding the harbour at the mouth of Churchill river. This land had been reserved from sale and settlement by order in council dated July 23, 1906. The survey was made by Mr. J. E. Morrier. Sufficient lines were run and marked on the ground to permit of dealing with the lots and cancelling the reservation.

The investigation of water-powers in the western provinces was continued by W. Thibandau, C.E. His operations during the last season covered the southwestern part of Alberta.

The Yukon-British Columbia boundary, which is the sixtieth parallel of latitude, was established from Tatshenshini river to Takhini river by J. N. Wallace, a distance of about thirty-six miles.

Two parties were employed on irrigation surveys in southern Alberta, under the direction of the Commissioner of Irrigation. They were in charge of Messrs. P. M. Sauder and R. J. Burley.



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Hereunder is the usual table of subdivision or settlement survey work completed each year since the inception of the surveys, with the result of last season's operations added:—

| Period.                     | Acres.      | Number of Farms of 160 acres each. |
|-----------------------------|-------------|------------------------------------|
| Previous to June, 1873..... | 4,792,292   | 29,952                             |
| 1874.....                   | 4,237,864   | 26,487                             |
| 1875.....                   | 665,000     | 4,156                              |
| 1876.....                   | 420,507     | 2,628                              |
| 1877.....                   | 231,691     | 1,448                              |
| 1878.....                   | 306,936     | 1,918                              |
| 1879.....                   | 1,130,482   | 7,066                              |
| 1880.....                   | 4,472,000   | 27,950                             |
| 1881.....                   | 8,147,000   | 50,919                             |
| 1882.....                   | 10,186,000  | 63,662                             |
| 1883.....                   | 27,234,000  | 170,212                            |
| 1884.....                   | 6,435,000   | 40,218                             |
| 1885.....                   | 391,680     | 2,448                              |
| 1886.....                   | 1,379,010   | 8,620                              |
| 1887.....                   | 643,710     | 4,023                              |
| 1888.....                   | 1,131,840   | 7,074                              |
| 1889.....                   | 516,968     | 3,231                              |
| 1890.....                   | 817,075     | 5,106                              |
| 1891.....                   | 76,560      | 476                                |
| 1892.....                   | 1,395,200   | 8,720                              |
| 1893.....                   | 2,928,640   | 18,304                             |
| 1894.....                   | 300,240     | 1,876                              |
| 1895.....                   | 406,240     | 2,539                              |
| 1896.....                   | 506,560     | 3,166                              |
| 1897.....                   | 428,640     | 2,679                              |
| 1898.....                   | 859,840     | 5,374                              |
| 1899.....                   | 1,022,720   | 6,392                              |
| 1900 (first 6 months).....  | 735,480     | 4,596                              |
| 1900-1901.....              | 1,603,680   | 10,023                             |
| 1901-1902.....              | 2,553,120   | 15,957                             |
| 1902-1903.....              | 6,173,440   | 38,584                             |
| 1903-1904.....              | 12,709,600  | 79,435                             |
| 1904-1905.....              | 10,671,520  | 66,697                             |
| 1905-1906.....              | 4,973,920   | 31,087                             |
| 1906-1907 (9 months).....   | 3,819,700   | 23,873                             |
| 1907-1908.....              | 6,123,049   | 38,269                             |
| 1908-1909.....              | 7,412,870   | 46,330                             |
|                             | 137,840,065 | 861,495                            |

## THE ASTRONOMICAL BRANCH OF THE DEPARTMENT.

Under this branch come the work of the Dominion Observatory, the International Boundary Surveys, and the Geodetic Survey of Canada.

The Observatory is provided with instruments for carrying on observations and investigations in several lines of astronomy, astrophysics and geophysics.

The principal instruments are: the equatorial, aperture, 15 inches; focal length, 19 feet; with several auxiliary instruments which may be attached to it; the meridian circle, aperture 6 inches, focal length 7 feet, diameter of circles, 3 feet; the cœlostæt, primary mirror, 20 inches diameter; focal length of concave mirror, 80 feet; Boscch seismograph, registering photographically; Riefler standard clock; and a master-clock for operating the time service of the city.

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The attachments to the equatorial instrument include: a camera for solar photography, a stellar photometer, a filar micrometer for visual observation of double stars, a single prism and a three-prism spectrograph, both of which have been designed specially for use in determining the velocity of stars in the line of sight, and have been constructed in the observatory workshop; a stellar camera, which is permanently attached to the tube of the telescope. The meridian circle and the cœlostast have only recently been put in operation. The former is installed in the new wing to the west of the main building. Defects showed themselves in the foundations of the piers built to carry the instrument and its collimators, and they had to be rebuilt, and special drains made to carry off the water which accumulates there. Some alterations had also to be made to the instrument itself. The cœlostast is set up in a building to the north of the main building, with which it is connected by a tunnel. A spectrograph, placed in a room in the basement, receives the solar image formed by the cœlostast mirrors. The purpose of the instrument may be in general terms defined as the investigation of the variations in the light and heat of the sun, the conditions accompanying sun spots, &c.

The time system by which dials in the principal government buildings in the city are operated from the Observatory, has been satisfactory. An additional group of dials has been placed in the Royal Mint, the Archives Building and the Printing Bureau. There are now in operation in all 276 dials and 12 clocks.

Two observers were employed during the summer in the determination of latitudes and longitudes of points with the purpose of improving the existing maps of Canada. Twenty-seven of these astronomical stations were occupied, including points in British Columbia, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia. One observer was occupied during the summer in magnetic observations at outside points.

The observatory is not connected with the weather service. No meteorological observations are taken at it, except certain self-recording observations of the temperature and the variations of barometric pressure, which are required for the proper interpretation of the records of the seismograph, to separate the effects of atmospheric variations in producing tremors in the earth's crust from the effects of internal movements.

The joint international boundary survey, provided for by the treaty of 1906, of the 141st meridian (between Yukon Territory and Alaska) was continued during the summer of 1908. The meridian was prolonged, and governing points established, for a distance of 75 miles south from the terminal point of 1907, and a point was reached about two miles south of White river. Fifty-two miles of the line, southward from the crossing of Yukon river, was marked by permanent monuments of aluminum bronze. The operations of the survey also comprised the continuation of the triangulation and the topographic survey along the line, and 159 miles of precise levelling, northward from Whitehorse, along the Dawson road.

Mr. A. J. Brabazon, D.L.S., had charge in the field of the Canadian share of the work.

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The second annual report by the United States and British Commissioners for this demarcation was laid before parliament on February 22, last.

The operations for the coming summer will include the production of the line northward from Yukon river, and southward from the terminal point of last season, near White river, to the Natazhat Range, the continuance of the triangulation and the topographic survey, and the placing of the final monuments at, and northward from White river, on the portion of the line the permanent marking of which is most immediately needed.

The demarcation of the line separating the coast strip of Alaska from British Columbia and Yukon Territory is carried on under the Treaty of 1903, as interpreted by the Tribunal which met in London in that year, and under the supplementary agreement of 1905.

This demarcation is carried on in sections by United States and Canadian parties, working independently but accompanied by a surveyor of the other party when identification has to be made of mountain peaks or other boundary points.

United States parties were placed at the crossing of Alsek river and in the region east of Unuk river. Each of these parties was accompanied by a Canadian representative.

A Canadian party under Mr. J. D. Craig defined the boundary line on the south branch of the Iskut river (a large tributary of Stikine river), completed the topographical survey of the region about the head of Bradfield river, and, in part, made a triangulation to connect the survey on the south branch of the Iskut with the former survey on the Stikine. This triangulation he was prevented by long continued rains from completing.

A Canadian party under Mr. W. F. Ratz continued the topographical survey east of Stephens passage.

The survey of this region was left incomplete in the joint surveys made in 1893 and 1894, and the Tribunal of 1903, in selecting the mountains which the boundary line should follow, found themselves unable to reach a decision as regards the region lying between a certain mountain situated north of Taku river and another lying some forty miles north of the Stikine. The distance between these two mountains is about 130 miles.

By the agreement made between the governments in March, 1905, seven inter-visible peaks between the Taku and Whiting rivers, and one peak to the north of the southern terminal point of the undefined stretch, were chosen as boundary peaks, thus reducing the undefined stretch to about 70 miles. As to this, it was provided in the agreement that the commissioners after making the necessary survey should select, as the final boundary peaks, inter-visible summits, no one of which should lie more than 2,500 metres away from the straight line joining the seventh and eighth of the peaks above mentioned. The carrying out of this agreement called for a very difficult

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topographic survey. The boundary line as defined in the agreement lies from ten to twenty miles from the coast, passing over an immense ice field out of which project the rocky summits of mountains reaching six to seven thousand feet or more above sea level. The coast line is bordered by a rugged range of little less height, and access to the interior is to be had only by a few narrow valleys and over the glaciers which discharge into them. Food, camp outfit and instruments have to be packed in on men's backs.

This survey was entrusted to Mr. W. F. Ratz, D.L.S., who in 1907 surveyed the southern part of this region from behind, penetrating westward from the Stikine river. In 1908 he entered from the west, from Holkham bay and its branches. The work of the two seasons completed the topographic survey of the whole region so that the commissioners have been enabled to select the peaks for the boundary, in accordance with the requirements of the executive agreement of 1905, and nothing remains to be done in this region but to make a triangulation survey connecting the selected peaks, so that the boundary may be properly described. It is hoped that this will be completed during the present year.

It is with great regret that I record the death of Mr. Ratz, which occurred in Ottawa on February 6, after a brief illness. Mr. Ratz was a graduate of the Ontario School of Practical Science, and was employed for some years in the Topographical Surveys Branch of the department. In 1905 he was transferred to the Boundary Surveys. Besides professional skill of a high order he possessed personal energy and practical ability which he proved by his successful management of the most difficult section of a difficult survey. His untimely death is a serious loss to the public service.

The re-survey of the 49th parallel which forms the international boundary from the Gulf of Georgia to the Lake of the Woods, was completed in 1907 from the sea to the summit of the main range of the Rocky mountains, with the exception of a short piece of triangulation in the Cascade range. This has since been finished, and work has been begun to the east of the Rocky mountains, under the direction of Mr. J. J. McArthur, D.L.S., who last summer surveyed one hundred miles of the line, beginning at Coutts, Alberta, and working eastward. Permanent monuments of cast-iron will be planted during the coming summer, to replace the old piles of loose stones of the original survey of 1872-75. These marks were placed at an average distance apart of three miles; the new monuments will be one mile and a half apart.

The re-survey of the boundary line between the provinces of Quebec and New Brunswick and the states of Maine, New Hampshire and Vermont, was continued. The initial point of the season's work was the monument at the source of St. Croix river. From this point the line (approximately a meridian) was surveyed to the St. John river, the vista cut through the woods, a plane table survey made of the country adjacent to the line, and permanent monuments placed. This re-survey and that of the 49th parallel were carried on under agreements between the governments of the United States and Great Britain, without special sanction of any treaty, the work being looked upon as merely a continuation or renewal of work already begun under treaty. As, however, it has been found necessary in many places not only to renew

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monuments formerly planted, but also to place intermediate ones, and as there were certain sections of the line which had been described by treaty, but had never been surveyed, it appeared desirable that a treaty should be negotiated providing for the systematic survey of the whole boundary line. Accordingly a treaty was negotiated between His Majesty and the United States, which was ratified on June 3, 1908, for the survey of the whole boundary from the Atlantic to the Pacific.

This treaty divides the line into eight sections, as follows:—

1. From the Bay of Fundy, through Passamaquoddy bay to the mouth of St. Croix river.
2. From the mouth to the source of St. Croix river.
3. From the source of St. Croix river to the River St. Lawrence.
4. Along the St. Lawrence river, through the Great Lakes, and along their connecting waters to the mouth of the Pigeon river in Lake Superior.
5. Along Pigeon river and other waters to the northwest angle of the Lake of the Woods.
6. From the northwest angle to the 49th parallel and along the latter to the summit of the Rocky Mountains.
7. From the summit of the Rocky Mountains, along the 49th parallel to the middle of the straits separating Vancouver island from the mainland.
8. Along the Straits of Georgia, Haro and Fuca to the Pacific Ocean.

Of the above sections, the second and the fifth were defined by former treaties, but have never been surveyed as the boundary. The first has been surveyed in part, and the fourth and the eighth have been laid down on charts but not referred to monuments. The other sections have been surveyed and marked with monuments, though in general with not a sufficient number to meet modern requirements. The treaty requires in the case of each section that the line be laid down on modern charts, as well as marked on the ground by monuments wherever that is practicable. Provision is made for the acceptance of the work done on certain sections under the executive agreements above referred to.

The survey of the fourth section in the St. Lawrence river and the Great Lakes is placed in the hands of the International Waterways Commission. Mr. O. H. Tittmann, superintendent of the United States Coast and Geodetic Survey, and Dr. W. F. King, chief astronomer of Canada, have been appointed commissioners for the carrying out of the treaty with respect to the other sections.

## THE GEODETIC SURVEY.

Two observing parties for the measurement of the angles of the triangles were in the field during the whole season, but on account of the prevalence of dense smoke were unable to do much work. The district covered lies between Brockville and Toronto, extending back some thirty miles.

Reconnaissance surveys were conducted in the maritime provinces, in the province of Quebec, in western Ontario and along the international boundary west of Lake Superior. The latter reconnaissance was, in part, for a primary triangulation to

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control the survey of the international boundary along the Pigeon river. The reconnaissance in the province of Quebec, which covered all of that part of the province lying south of the St. Lawrence river from Montreal to a point thirty miles below the city of Quebec, together with a strip north of the river extending far enough back to secure high points to command the country to the southeast, was most gratifying in its results; an excellent system of quadrilaterals was secured and some large five and six-sided figures with central points.

In the maritime provinces reconnaissance has been satisfactory. The stations selected for the triangulation extend from Chamecock mountain in the southwest corner of New Brunswick to the northerly extremity of Cape Breton Island, embracing a district about fifty miles wide between those points, including the easterly portion of Prince Edward Island. Chamecock mountain is one of the primary triangulation stations of the United States Coast and Geodetic Survey and by it in conjunction with Trescott Rock, another primary station of the same survey, a direct connection is made with the Geodetic Survey of the United States.

In 1908, two Geodetic levelling parties were employed and a line of precise levels was carried from Coteau Junction, thirty-eight miles southwest of Montreal, to Fort Erie via Hamilton, and also from Hamilton to London. The computations are now in progress and are sufficiently advanced to show that the results are of a high order of precision.

Reference may be made to the report of the Chief Astronomer, Part No. IV. of this report, for fuller details of the work of the Astronomical Branch.

#### NATIONAL PARKS.

The national parks continue to grow in popularity, as shown by the large increase in the number of tourists and temporary residents who visited these charming resorts during the year. Over 39,780 persons visited Banff during the past fiscal year, as against 32,209 during the previous year, and 7,389 a decade ago. This increase of visitors was accompanied by an increase of revenue, the collections during the fiscal year closed amounting to \$31,321.20 as against \$27,232.87 in the previous year and \$2,994.16 during the fiscal year 1898-9.

The presence of 25,209 people at the Government Bath Houses during the year indicates very forcibly the need for more adequate bathing accommodation. The erection of a commodious bathhouse at the Hot Springs, equipped according to modern ideas, is a question which is being forced upon the department for early consideration.

Satisfactory progress has been made in the organization and systematization of the work connected with the national parks. Regulations based upon the Rocky Mountains Park Act have been revised and amended, and by order in council have been made to apply to the Rocky mountains, Yoho, Glacier and Jasper parks. It is expected that these regulations will facilitate the administration of these parks and afford increased protection to the game and fish within their precincts, as well as assist in the prevention of fire.

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The transfer of some 325 of the buffalo purchased from Mr. Michel Pablo, of Montana, in the year 1907, from Elk Island Park to Buffalo Park, situated near Wainwright on the Grand Trunk Pacific Railway, was successfully accomplished; as was also the delivery of another shipment of 190 head from Montana. The task of rounding up the latter, transporting them individually in specially constructed wagons to the loading point, and shipping them over nearly 1,300 miles of railway to their new home with insignificant loss, constituted a work of such magnitude as only the experienced eye witness can appreciate, and is probably without precedent in history. The work of rounding up the balance of this famous herd will be continued by Mr. Pablo during the present summer; and when this balance is delivered to Buffalo Park, together with the surplus stock from the Banff herd, Canada will possess the largest number of buffalo (or of any wild animals) within a single inclosure, in the world.

In consideration of the tide of travel to the Seattle Exhibition this summer, a profusely illustrated pamphlet setting forth the attractions of the Canadian National Parks has been issued. This pamphlet, entitled 'The Prince of Playgrounds,' is being freely distributed at the Seattle fair, and will doubtless divert a great deal of tourist traffic through the parks to view the wondrous beauties of this most providentially favoured region of Canada's dominions.

In the years 1904 and 1905 there were transferred to this department to be administered as public parks, a dozen islands in the St. Lawrence river lying between Brockville and Gananoque. These islands, with a single exception, were purchased from the Mississagua band of Alhwick and are reserved for recreative purposes. Upon six of the islands, which are well situated and beautifully wooded, pavilions have been erected and equipped with stoves, tables, benches, &c., and are under the care of a guardian.

The numbers of excursionists, picnic parties and other pleasure seekers visiting these islands would appear to justify their reservation from sale; and it will devolve upon this department to see that the pavilions and other conveniences are maintained in good sanitary condition and repair.

## FORESTRY AND IRRIGATION.

The report of the Superintendent of Forestry and Irrigation for the year ended March 31 last, will be found under Part VII. of the general report.

The interest in tree planting still continues and the distribution of young trees for the past year was the largest yet recorded. In order to provide better facilities for handling this increased work, all applications for trees are now dealt with at the office at Indian Head, which is the headquarters of the Chief of the Tree Planting Division, and where the Forest Nursery Station is situated.

An important feature of the year's work was the removal of squatters from the forest reserves. This work is now practically completed, thus removing a great source of danger from fires within the reserves.

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The surveys of 'The Pines' and 'Riding Mountains' forest reserves have been completed and similar work is to be undertaken at an early date on the other reserves.

Systematic effort is being made to collect statistics regarding the forest resources of Canada and the annual production of timber, but the collection of such statistics is necessarily tedious, and it will be some time before the record is even approximately complete.

Continued attention has been given to the work of protecting the forests from fire and special efforts have been made to prevent, or control, fires along the line of railways now under construction.

Special attention is being given to stream measurements. This work was previously conducted as part of the irrigation administration, but has now been given a separate organization. This work is at present confined chiefly to the streams in southern Alberta and southwestern Saskatchewan, in the sub-humid or semi-arid district, but it is intended to extend it as rapidly as possible and ultimately to cover all of both provinces. The importance of this work cannot be over-estimated, as upon the water supply will depend, to a very large extent, the future development of a considerable section of the west, and an accurate knowledge of existing conditions should precede any attempt to improve them.

The greatest irrigation development during the past year has been in connection with the larger irrigation projects now under construction by chartered companies, although there has been some development in the Cypress Hills country by individuals.

#### SCHOOL LANDS.

In consequence of the comparatively poor harvest of the year 1907, and of the financial depression then existing, it was not considered expedient to hold any general auction sales of school lands in the provinces of Manitoba, Saskatchewan and Alberta during the season of 1908, and only a few isolated parcels were disposed of.

As you are aware, special legislation was recently obtained to enable the department to sell by private sales to boards of trustees the land required for school sites in school sections, instead of by public auction, as it was found that the expenses in connection with the auction sales of these small parcels, which were put up separately, were out of all proportion to the amount realized, and also involved a good deal of trouble and inconvenience to the school authorities.

Under the amendment to the Dominion Lands Act referred to, the department is now empowered to sell by private sale to boards of trustees the land required in school sections for school sites, provided that the application of the trustees is endorsed by the Minister or Deputy Minister of Education for the province, and that the parcel does not exceed four acres and fronts on a road allowance.

Under this provision of the Act a number of sales have already been made to trustees, and the system is found to work well.



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A number of sales were also made under the Railway Act to railway companies of school lands required for right-of-way and station grounds, ballast pits, and other purposes of the railway.

An important change was made during the fiscal year in the manner of renting school lands for grazing, grazing permits having been substituted for the grazing leases heretofore issued.

Under these leases great difficulty was experienced in collecting the rental, the lessees in many instances paying no attention to the notices sent them from time to time; and although the accounts were in all such cases then placed in the hands of the inspector for collection, he frequently found on visiting the land that the lessee was either absent, or claimed to be unable to meet the payment at the time, and as the sum involved was generally inconsiderable it was not worth while collecting by process of law, and it was consequently lost to the Crown.

Under a grazing permit, however, there can be no arrears of rental, as the permit is not issued until the rental is paid, and it lapses on April 1 in each year, and, while it is renewable from year to year at the option of the department, the renewal is not made unless application for the same is received on or before February 1, accompanied by the rental for the next year.

Where the applicant fails to renew the permit by the date mentioned, the department is at liberty to rent the land to the next applicant.

This system not only prevents any arrears accruing, but also saves a considerable amount of time in correspondence, and also does away with the necessity of keeping accounts in connection with the lands rented.

During the past fiscal year, prior to the issue of the grazing permit, 160 grazing leases were issued, and since then 291 grazing permits have been granted.

The net revenue from these grazing lands for the fiscal year was as follows:—

|                        |            |
|------------------------|------------|
| Manitoba . . . . .     | \$1,125 67 |
| Saskatchewan . . . . . | 9,103 89   |
| Alberta . . . . .      | 9,552 41   |

The revenue from coal lands for the fiscal year was \$4,141.92.

The report of the Chief of the School Lands Branch shows that the net revenue, from all sources, from school lands during the fiscal year was as follows:—

|                        |                     |
|------------------------|---------------------|
| Manitoba . . . . .     | \$365,430 16        |
| Saskatchewan . . . . . | 172,754 90          |
| Alberta . . . . .      | 143,440 40          |
| Total . . . . .        | <u>\$681,625 46</u> |

Of this sum \$642,985.87 was collected at head office, and the balance of \$38,639.59 through the various Dominion lands agencies.

The expenditure for the fiscal year is as follows:—

|                        |              |
|------------------------|--------------|
| Manitoba. . . . .      | \$6,872 13   |
| Saskatchewan . . . . . | 6,947 00     |
| Alberta. . . . .       | 6,840 60     |
|                        | <hr/>        |
| Total. . . . .         | \$ 20,659 73 |

This sum is as nearly as possible 3 per cent of the net revenue, which I consider a very moderate amount for the administration of the school lands in the three provinces.

The balance to the credit of the several School Lands Funds on March 31, 1909, is as follows:—

|                       |                |
|-----------------------|----------------|
| Manitoba. . . . .     | \$2,185,311 51 |
| Saskatchewan. . . . . | 850,398 41     |
| Alberta. . . . .      | 452,123 39     |

In accordance with the orders in council in that behalf cheques were issued in favour of the Provincial Treasurer of each of the provinces of Manitoba, Saskatchewan and Alberta covering the revenue collected from school lands during the fiscal year other than principal moneys of sale, the amount paid over to each province on this account after deducting the cost of management being as follows:—

|                       |              |
|-----------------------|--------------|
| Manitoba. . . . .     | \$108,895 41 |
| Saskatchewan. . . . . | 52,113 24    |
| Alberta. . . . .      | 54,239 84    |

In addition to the foregoing, the following amounts were paid over by the Finance Department to the several provinces as interest on the fund for the fiscal year, namely:

|                       |              |
|-----------------------|--------------|
| Manitoba. . . . .     | \$ 62,161 11 |
| Saskatchewan. . . . . | 24,289 14    |
| Alberta. . . . .      | 12,790 09    |

#### YUKON TERRITORY.

Methods of mining in the Yukon Territory are gradually undergoing a very pronounced change. Individual effort by comparatively primitive methods is being replaced by combined operation with the most modern equipment, the results of which appear to be very satisfactory. Combination, with operations on a more extensive scale, has resulted in materially reducing the cost of production.

The water-powers of the territory are being utilized for the generation of electric energy for the operation of dredges, elevators, &c., and in all cases where possible, mechanical appliances are being substituted for manual labour, with very satisfactory results.

The gold production for the year shows a considerable increase, and it would appear that the completion by The Yukon Gold Company of their extensive water

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system, as well as the introduction of additional dredges and other forms of improved mining machinery, will result in a steady increase in the annual gold output of the territory.

Quartz prospecting operations appear to have been carried on with greater activity than in the past. A stamp mill is being installed at the head of Victoria gulch, where gold-bearing quartz has been found, and a concentrator has been erected, and is in full operation in the Conrad district, where discoveries were made some years ago, and where considerable development work has been performed.

Agriculture has now become a very important adjunct to the resources of the territory. While formerly all vegetables consumed in the territory were imported, now vegetables in abundance are being locally grown, and continuous cultivation would appear to increase the productiveness of the soil. Entries have been granted for a number of homesteads, and the cultivation of the soil appears in numerous cases to have been undertaken as a permanent occupation.

I have the honour to be, sir,

Your obedient servant,

W. W. CORY,  
*Deputy of the Minister of the Interior.*



PART I.  
DOMINION LANDS.



# DOMINION LANDS.

## No. 1.

### REPORT OF THE COMMISSIONER.

DEPARTMENT OF THE INTERIOR,  
OFFICE OF COMMISSIONER OF DOMINION LANDS,  
OTTAWA, April 1, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I beg to submit my report for the twelve months ending March 31, 1909, on the Dominion Lands Branch of this department, together with the reports of the Inspectors of Dominion Lands Agencies and the agents of Dominion Lands for the several districts.

The following summary statement has been prepared of the work transacted during the period mentioned as compared with the corresponding twelve months during the previous year :—

|   |         |         |
|---|---------|---------|
|   | 1909.   | 1908.   |
| Number of files dealt with. . . . .                     | 178,830 | 147,794 |
| Letters written. . . . .                                | 149,178 | 125,430 |
| Triplicates. . . . .                                    | 96,707  | 80,014  |
|   | 245,885 | 205,444 |
| Applications for patent—                                |         |         |
| Number examined. . . . .                                | 30,760  | 27,557  |
| New applications . . . . .                              | 19,051  | 15,269  |
| Certificates issued and notifications sent out. . . . . | 20,256  | 15,215  |

I have the honour to be, Sir,  
Your obedient servant,

J. W. GREENWAY,  
*Commissioner of Dominion Lands.*

## No. 2.

### REPORT OF INSPECTOR OF DOMINION LANDS AGENCIES.

(*J. W. Martin.*)

OFFICE OF INSPECTOR OF DOMINION LANDS AGENCIES,  
MEDICINE HAT, ALBERTA, May 15, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit my annual report for the year ending March 31, 1909.

Prior to the 1st of February last, I was assistant inspector of Dominion lands agencies, assisting Mr. R. E. A. Leech, who had charge of the four provinces of Manitoba, Saskatchewan, Alberta and British Columbia; and on that date, I was appointed as inspector of agencies for the provinces of Alberta and British Columbia, and there-

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fore kept no records in my office of the business transacted throughout the west prior to that date. These records, however, were all carefully kept in the office of Mr. Leech, at Brandon, and as he will no doubt in his annual report give a statement of the business transacted by the agents, sub-agents and homestead inspectors throughout the west, I will not attempt to duplicate these statements. Mr. Leech's report will no doubt cover everything fully.

On the 1st of September last, the new Dominion Lands Act came into force, throwing the odd numbered sections at the disposal of the government open to settlement, and as this made it much easier for intending settlers to secure suitable homesteads, a large immigration commenced at that date, and a great number of quarter sections have been taken up since then. In the month of September, more quarter sections were disposed of than in any month since the land throughout the west became available for settlement. Since the 1st of September, on account of this large influx of intending settlers, and the tremendous volume of business transacted at the agencies, it has been necessary to increase nearly every office staff in my district, in order to cope with the current work successfully, which has, I am pleased to state, been accomplished.

Last year, the government saw fit to distribute seed grain to farmers throughout the west, on account of the scarcity of seed, and for several months I was at Edmonton assisting in the distribution of the grain. In order to distribute this satisfactorily, it was necessary to have most of the homestead inspectors in Alberta assisting the railway agents in distributing, and also for the purpose of seeing that the cars were arriving at the different distribution points promptly. The taking of the homestead inspectors for this work materially interfered with their regular duties, and their absence from their regular duties is still being felt. However, the work in this branch is increasing rapidly, and it was seen fit to appoint three new inspectors in Alberta, and I am very pleased to be able to state that the work is being caught up rapidly.

Most of the sub-agencies have also been very busy, and it was necessary to increase the number of sub-agencies in Alberta materially, especially in the northern part of the province, as settlement has extended back. These sub-agencies have all been inspected regularly and, in most cases, the work has been carried on in a very satisfactory manner. As lands in certain localities are well settled, and people become entitled to patents, the work at the sub-agencies affected will be materially decreased, and it will be necessary from time to time to close up some sub-offices. It will also be necessary, on account of settlement extending a long way back in different directions, to open up new sub-offices, which the department so far has been very prompt in doing.

I have, during the fiscal year just ended, taken up quite a large number of special cases, or investigations, for the department, which have been dealt with promptly and satisfactorily on receipt of the necessary reports.

On account of the settlement which has taken place during the year in what is known as the Peace River country, I understand it is the intention of the department to establish an agency at Lesser Slave lake to attend to this district. This should be a great convenience to people who wish to settle in the northern part of the province, and no doubt from now on, as the land is being surveyed rapidly, a large proportion of intending settlers will visit that district for the purpose of taking up land.

It is expected that before the close of the next fiscal year, branch lines of railways now established through the west will have been run reaching through portions of the province of Alberta which are at present practically unsettled, and also into portions of the province in which, during the past year, settlers have been flocking, and which are at the present time a long way from a railway. These settlers went back into these remote districts with the expectation of having railway facilities in the near future, and a great many of them will apparently not be disappointed in this respect.

Indications point to a very large settlement the coming year, and I look for a large increase over the year just closed.



## SESSIONAL PAPER No. 25

In the past, a large area of coal land has been disposed of, and it is apparent from all information received, that coal mines are being opened up in all parts of the country for the purpose of supplying settlers with coal for domestic uses, and where these mines are close to railways, large quantities are being shipped to the cities and towns throughout the west. I have no doubt also that as the railway facilities are increased during the coming season, the quantity of coal mined next year will be largely increased over the past season.

This spring has been quite backward, there being a very large rainfall. However, all indications point to the crop being, if anything, above the average.

Your obedient servant,

J. W. MARTIN,  
*Inspector.*

## No. 3.

## REPORT OF INSPECTOR OF DOMINION LANDS AGENCIES.

(*R. E. A. Leech.*)

OFFICE OF INSPECTOR OF DOMINION LANDS AGENCIES,

BRANDON, MANITOBA, June 12, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I beg to submit my report for the fiscal year ending March 31, 1909.

The past year has been one of great activity in the administration of Dominion lands in the west, due to the distribution of over a million and a quarter bushels of seed grain, and to the operation of the new Land Act, which became effective September 1, 1908, throwing all unalienated Dominion lands open to entry and also providing for pre-emption and purchased homestead entry on lands within a prescribed area.

The distribution of seed grain referred to is presented in concise form in a report I made to the Deputy Minister, July 20, 1908, a copy of which is appended hereto. I should, upon this point, add that on August 15, 1908, I closed the seed grain offices in Regina, shipping all the records to the Seed Grain Branch, Department of Interior, Ottawa, for the completion of the unfinished business.

The work of the land offices during the past year has been by far the largest yet recorded. The land entries for the twelve months totalled 54,254, which exceeded the previous high water mark, 1905-6, by 12,315.

The largest number of entries put through one land office in a month was 4,447; this was done at Moosejaw in the month of September, 1908, and more than doubled the past record for one month, which was held by Regina. The record for the largest number of entries put through a land office in one day is also held by Moosejaw, where on December 22 last, 724 entries were completed. Also the revenue has, this last year, exceeded the million dollar mark, and the previous record by \$58,574.30.

Foreign interest in the Canadian west has not in the least abated, and constant streams of settlers are arriving to take up the free government lands or to make purchases of other lands. These settlers are of a most desirable class, being well supplied with farming requirements or the means to procure the same.

## INSPECTION OF OFFICES.

My inspections of the offices have been made and reported to you from time to time, and almost invariably the work has been found in good shape, the books and records well kept and the records in good order, and the routine work well up to date, though this has, in a number of cases, required considerable overtime work on the part of the office staffs.

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From the monthly reports received from the agents, sub-agents and homestead inspectors, and by constant travel, I am able to keep in close touch with the work.

During the past year I have travelled 51,121 miles by rail and 375 miles by team, making a total of 51,496 miles.

## SUB-LAND OFFICES.

During the past year it has been deemed advisable to close the sub-land offices at Etoimami, Strassburg and Milestone, Saskatchewan, and Pincher Creek, Alberta.

New sub-land offices were opened at St. Paul de Metis, Pine Creek and Entwistle, in Alberta, and Gull Lake and Lanigan, in Saskatchewan. The reports of the inspections made of sub-land offices have been forwarded to you as they were made.

## INSPECTION OF THE GOVERNMENT PARK RESERVATIONS.

In addition to the inspection of the land offices, I have also kept in touch with and inspected the Banff, Yoho and Rocky Mountains Parks. During the past winter it was deemed advisable to close the Yoho Park office; my report on this being forwarded at the time.

Attached also are the following comparative statements of the work :—

- A. Land offices, principal transactions.
- B. Sub-land offices, principal transactions.
- C. Homestead inspectors, principal work performed.

I beg to remain, Sir,

Your obedient servant,

R. E. A. LEECH,

*Inspector of Dominion Lands Agencies.*

## REPORT ON DISTRIBUTION OF SEED GRAIN.

REGINA, SASKATCHEWAN, July, 20, 1908.

W. W. CORY, Esq.,

Deputy Minister of the Interior,  
Ottawa.

SIR,—In connection with seed grain distribution work I beg to make an interim report, as follows :—

At the request of the Minister of the Interior I took charge of the distribution of seed grain in the provinces of Saskatchewan and Alberta, as per the agreements entered into between the Minister of the Interior and the representatives of the Saskatchewan and Alberta governments. In Ottawa, in the latter part of January and first of February, I arranged for the printing and distribution of notices and circulars, regarding the terms and conditions of the proposed seed grain distribution, forms of applications, liens, mortgages, &c.

On February 11 I arrived in Regina to open offices and organize a staff for handling the work. By the terms of the regulations governing the seed grain distribution, applications were to be made in duplicate before the secretary-treasurers of local improvement districts, Dominion land agents, sub-land agents, homestead inspectors, immigration agents or Northwest Mounted Police; the original to be immediately forwarded to my office, afterwards to be forwarded to the various land offices, or provincial authorities, for verification as to the interest of applicants in the lands described; the duplicate to be approved, or otherwise, by the council of the local improvement district and, subsequently, forwarded to me.

## SESSIONAL PAPER No. 25

In order to meet the requirements of section 13 of the agreements made in Ottawa, February 3, between the Minister of the Interior and the representatives of the Saskatchewan and Alberta governments, respectively, I was notified that Mr. D. S. McCannel was appointed to represent the Saskatchewan government, and Mr. George Stevenson was appointed to represent the Alberta government. Those representatives opened offices, convenient to my own, and their approval was had to all applications made by non-homesteaders, for the respective provinces, before seed was delivered.

In order to facilitate keeping an accurate and readily available record of applications, I prepared registers and divided the work by land districts. In those registers the following quotations are made:—

'Application Number,' 'Name,' 'Post Office Address,' 'Declaration of Land,' 'Original Application Received,' 'Amount Applied for,' 'Date Original Application sent Land Office,' 'Date Original Application sent Provincial Government,' 'Date Original Application received back,' 'Amount Finally Recommended,' 'Papers sent Railway Agent, giving date and Station,' 'Date Lien received from Railway Agent,' 'Amount of seed supplied, Wheat, Oats and Barley,' 'Amount charged to Government, Dominion, Saskatchewan, Alberta and Cash Sales.'

On February 13 the first applications were received. February 22 was the first date fixed for closing applications. The time for receiving applications, however, was extended from time to time and was, eventually, left open. The last application received was June 16, and seed was delivered on this application. Altogether, 16,615 applications were received and dealt with by this office.

As applications were finally approved they were listed for shipment under the stations at which the applicants desired their seed delivered. Each day, as the approved applications for any railway station made up a car lot of any given grain, a requisition was issued upon Mr. Charles C. Castle, Purchasing Agent, Winnipeg, for the shipment of the same.

The first of such requisitions was made February 28 for 26 cars, and daily requisitions, as required, were made subsequently during the shipping season. The last requisition was made May 13. The total requisitions are as follows:—

|             | Cars. |
|-------------|-------|
| Wheat.....  | 500   |
| Oats.....   | 482   |
| Barley..... | 39    |

In addition to this, however, grain was shipped on the requisition of Hon. W. T. Finlay, for the province of Alberta, as follows:—

|            | Cars. |
|------------|-------|
| Wheat..... | 2     |
| Oats.....  | 14    |

which will also be accounted for through this office. In all 1,037 cars of seed were shipped out for distribution.

When seed was shipped by Mr. Castle, the shipping bills were sent to this office, invoices accompanying the same, which were noted in our records. To the shipping bill, for each car, were attached a delivery list with liens and mortgages for execution by the applicants before the railway agents at time of delivery, it being necessary to take a separate mortgage, or lien, for each kind of grain, owing to the deliveries being made at different times. For each car of seed the number of deliveries to be made to applicants varied from 20 to, in one instance, 121, requiring the execution of as many securities. The first shipping bills were received at this office March 11 and were for 67 cars, and on the same day were sent forward to the various railway agents (or in the case of flag stations, to homestead inspectors) with the necessary delivery lists, liens and mortgages attached; also, each applicant was notified of the seed being shipped. As it was important that applicants should be able to receive the seed as soon

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as it reached its destination, we made it the rule of the office that all the shipping bills should be sent forward, with lists, liens, mortgages, &c., on the day that they were received, and I am pleased to be able to report that while we received as high as 81 shipping bills in one day, none ever remained over night in our office.

Seed was delivered at 175 stations in Saskatchewan and 75 stations in Alberta, making 250 stations in all; and the quantities ranged from a very few bushels up to, in one instance, 32 cars at one station.

In accordance with the arrangements made with the Canadian Pacific and Canadian Northern Railways their agents made delivery of the grain at the railway stations, and had the necessary documents executed. This was a very important part of the work, and, on the whole, has been done in a satisfactory manner. Deliveries at flag stations were attended to by homestead inspectors.

Owing to the enormous amount of work in connection with deliveries, I arranged for homestead inspectors to supervise the work on all railway lines, allotting to each a certain territory which they attended to in addition to flag stations. By this means railway agents having heavy deliveries were given assistance. As the deliveries for each car were completed the railway agent was requested to give a 'return statement' showing the deliveries as they had been made, on a form provided, and attach thereto the securities taken. Up to the present time these 'returns' and securities have not all been received at this office, but they will probably reach a total exceeding 30,000 in number. A separate file was made for each applicant, to which was attached his application in duplicate, all correspondence in connection therewith, and the liens, mortgages or cash sale invoices taken in settlement for seed delivered.

As liens, mortgages or cash sale invoices are received they are entered into our 'out-turn' grain books and our 'application' register, and attached to the proper application files. When all liens, mortgages or cash sale invoices relating to an application file are received, the file with the securities is immediately transferred to Ottawa in the case of homesteaders, and to the provincial authorities respectively in the case of non-homesteaders.

Duplicates of non-homesteaders' files are made and the same forwarded to Ottawa.

At the present time about 50 per cent of the files have been disposed of in the above manner.

#### UNSATISFACTORY SEED.

In every case where complaint was made about the seed supplied not being satisfactory, I immediately had an investigation made—in most instances by a deputy grain inspector—and where the seed, upon examination, was not thoroughly satisfactory, I immediately stopped delivery of the same and requested applicants who had received such seed to return it, when satisfactory seed would be substituted. Many complaints, however, proved to be not well founded, and more particularly in connection with oats.

The earlier deliveries of oats were western grown. Later, when English oats were being delivered, being of such superior quality, many became dissatisfied with the western oats they had received. Up to the present time, however, I have not had a complaint that the oats supplied have failed to grow satisfactorily.

I have had a few complaints of seed wheat not giving satisfactory germination, and am having each case thoroughly investigated. So far as these cases have been reported upon it is clearly evident that the seed was seriously injured by formalin treatment by the farmer previous to sowing.

#### ALLOTMENTS NOT CALLED FOR.

Considerable quantities of seed delivered to various points were not called for by applicants. These refer particularly to applications for barley. In the application form each applicant was asked to state whether, in the event of the kind of grain applied for not being available, he would be satisfied to have some other kind of grain substituted. Almost invariably applicants consented to this suggestion.

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In connection with barley it was found that only about one-third of the quantity required could be secured, and oats were therefore substituted on applications for barley. When those substituted oats arrived at destination points the farmers appeared to be disappointed in not receiving barley; and the season then being somewhat late, they, in a great many instances, preferred not to take oats. There were also many cases where people living long distances from the railway stations did not receive the notice of their grain being shipped, in reasonable time. Also, there were a number of cases where settlers had rivers and streams to cross to reach the railway station, and having to depend upon ferry crossings, which owing to high water, were unable to operate, they were disappointed in not being able to take the seed they required.

## QUALITY OF SEED.

Out of 1,037 cars sent out for distribution the entire complaints received will only refer to about 15 cars, and of this number there does not appear to have been reasonable ground for complaint against more than eight cars, which is quite a small percentage of the entire shipments.

The seed, generally, appears to have been carefully inspected and well cleaned. I have scores of letters expressing appreciation and satisfaction, both as to quality of seed, prices for the same, and the manner in which the business was handled in connection with seed distribution.

Owing to the very short time between the commencement of seed grain distribution operations and seeding time it required a large office staff to handle the business. For three months my staff of about 35 in number worked every day from 7 a.m. until nearly midnight, and sometimes even later. I am pleased, however, to be able to report that each day's business was cleared up on the day it was received, and that no oversight or miscarriage appears to have occurred in connection with a single application.

## SEED GRAIN DISTRIBUTION A NECESSITY.

While the distribution did not reach the proportion anticipated, there is no question as to the necessity for making the distribution. In many districts seed was not available, and settlers had not the means to purchase the same. Owing to the general financial stringency settlers were unable to borrow, even upon good securities. I believe I am well within the mark in saying that 500,000 acres have been seeded which would not have been were it not for the present seed grain distribution.

A considerable additional acreage would probably have been sown with inferior seed which would have given poor results. This upon an average crop return will yield an extra eight or ten million dollars to the crop returns for this year in the provinces of Saskatchewan and Alberta.

Attached hereto please find schedules as follows:—

1. The number of applicants by land districts to whom seed grain was advanced, and whether upon homesteaders' liens, seed grain mortgages or cash sales.
2. The number of applications rejected or cancelled, by land districts.
3. Statement of grain distributed at railway stations in Saskatchewan, showing the kind, quantities and grades of grain delivered.
4. Statement of grain distributed at railway stations in Alberta, showing the kind, quantities and grades of grain delivered.
5. A statement showing the total seed grain delivered.

I have the honour to be,

Your obedient servant,

R. E. A. LEECH,

*Inspector of Dominion Lands Agencies.*

N.B.—Railway agents in some cases not having sent in *final returns* of deliveries made, the figures in the schedules hereto in some cases are approximated, and will be subject to correction when completed returns are available.

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## SCHEDULE No. 1.—NUMBER of applicants receiving seed grain and terms of settlement.

| Land District.       | Settlement by |            | Cash Sales. | Total. |
|----------------------|---------------|------------|-------------|--------|
|                      | Liens.        | Mortgages. |             |        |
| <i>Saskatchewan.</i> |               |            |             |        |
| Humboldt.....        |               |            |             |        |
| Battleford.....      | 1,472         | 302        | 21          | 1,795  |
| Prince Albert.....   | 728           | 131        |             | 859    |
| Regina.....          | 215           | 154        |             | 369    |
| Yorkton.....         | 875           | 1,361      | 56          | 2,292  |
| Moosejaw.....        | 1,501         | 2,100      | 84          | 3,685  |
| Estevan.....         | 796           | 92         | 11          | 899    |
| Brandon.....         | 259           | 1,025      | 17          | 1,301  |
|                      | 90            | 490        | 12          | 592    |
|                      |               |            |             | 11,792 |
| <i>Alberta.</i>      |               |            |             |        |
|                      | 5,936         | 5,655      | 201         |        |
| Edmonton.....        | 1,125         | 1,047      | 144         | 2,316  |
| Lethbridge.....      | 90            | 27         | 13          | 130    |
| Red Deer.....        | 216           | 314        | 24          | 554    |
| Calgary.....         | 199           | 219        | 66          | 484    |
|                      |               |            |             | 3,484  |
| Total.....           | 1,630         | 1,607      | 247         | 15,276 |

R. E. A. LEECH,  
Inspector of Dominion Lands Agencies.

## SCHEDULE No. 2.—STATEMENT showing the No. of applications rejected and cancelled.

| Land District.       | Cancelled Applications. |
|----------------------|-------------------------|
| <i>Saskatchewan.</i> |                         |
| Humboldt.....        | 115                     |
| Battleford.....      | 157                     |
| Prince Albert.....   | 37                      |
| Regina.....          | 127                     |
| Yorkton.....         | 193                     |
| Moosejaw.....        | 73                      |
| Estevan.....         | 80                      |
| Brandon.....         | 29                      |
|                      | 816                     |
| <i>Alberta.</i>      |                         |
| Edmonton.....        | 265                     |
| Lethbridge.....      | 23                      |
| Red Deer.....        | 119                     |
| Calgary.....         | 116                     |
|                      | 523                     |
| Total.....           | 1,339                   |

R. E. A. LEECH,  
Inspector of Dominion Lands Agencies.

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## SCHEDULE No. 3.—STATEMENT of Grain Distribution at Railway Stations in Saskatchewan.

| Station.     | Wheat. |       |       |       | Oats. |       |       | Barley. |
|--------------|--------|-------|-------|-------|-------|-------|-------|---------|
|              | 1 Nr.  | 2 Nr. | 3 Nr. | 4 Nr. | 1 Wh. | 2 Wh. | 3 Wh. |         |
| Aberdeen     | 1,628  |       |       |       |       |       |       | 13      |
| Abernethy    | 1,250  |       | 1,750 |       |       | 777   |       | 355     |
| Alameda      |        |       | 6,207 | 1,050 |       |       |       | 1,785   |
| Antler       | 700    |       | 2,888 | 3,075 |       | 5,111 |       | 663     |
| Arcola       | 2,750  | 1,050 | 4,505 | 4,858 | 336   | 2,960 |       | 683     |
| Asquith      | 1,050  |       |       | 1,309 |       |       |       | 1,170   |
| Balcarres    | 1,034  | 1,684 | 3,692 |       |       | 1,200 |       | 3,505   |
| Balgonie     |        | 2,232 | 3,436 |       |       | 1,800 |       | 2,013   |
| Battleford   |        | 2,234 | 3,924 | 1,000 |       | 5,502 |       | 3,650   |
| Belle Plain  |        |       | 220   |       |       |       |       | 380     |
| Benito       |        |       | 1,050 |       |       |       |       | 2,035   |
| Bethune      | 1,000  |       |       | 1,419 |       |       |       | 1,214   |
| Bienfait     |        | 113   | 4,146 |       |       |       |       | 2,746   |
| Birch Hills  |        | 113   |       |       |       |       |       | 1,046   |
| Bladworth    |        |       | 1,530 |       |       |       |       | 970     |
| Blucher      | 700    |       |       | 467   |       |       |       | 1,536   |
| Borden       |        |       | 905   |       |       |       |       | 490     |
| Bredenbury   |        | 205   |       |       |       |       |       | 297     |
| Bresaylor    |        | 30    |       |       |       |       |       | 180     |
| Broadview    | 676    |       | 454   | 1,016 |       |       |       | 1,565   |
| Bruno        |        | 200   | 1,090 |       |       |       |       | 1,102   |
| Buchanan     |        |       | 1,016 |       |       |       |       | 6,896   |
| Canora       | 830    | 2,324 | 2,966 | 1,008 |       | 1,722 |       | 29,022  |
| Carievale    |        | 1,000 | 615   |       |       |       |       | 500     |
| Carlyle      |        |       | 3,196 | 9     |       | 1,710 |       | 235     |
| Caron        |        |       | 1,000 |       |       |       |       | 1,620   |
| Carduff      |        |       | 1,181 |       |       |       |       | 640     |
| Chamberlain  |        |       | 1,727 |       | 89    |       | 1,050 | 861     |
| Churchbridge | 650    |       | 902   | 710   |       | 1,800 |       | 2,095   |
| Condie       | 1,050  |       | 200   |       |       |       |       | 55      |
| Craik        |        |       | 2,425 | 350   |       | 1,236 |       | 810     |
| Creelman     | 1,922  | 968   | 3,357 | 134   |       | 1,800 |       | 1,235   |
| Cupar        | 1,050  | 397   | 3,071 | 2,200 |       | 6,625 |       | 635     |
| Dana         |        |       | 2,448 |       |       |       |       | 2,247   |
| Davidson     | 1,050  | 1,050 | 2,628 | 3,044 |       | 1,836 |       | 3,620   |
| Disley       |        |       | 1,010 | 609   |       |       |       | 379     |
| Drinkwater   | 253    |       | 640   |       |       |       |       | 2,678   |
| Dubuc        | 180    | 650   | 3,147 | 1,100 |       | 1,170 |       | 3,216   |
| Dundurn      |        |       |       | 1,785 |       |       |       | 1,084   |
| Duck Lake    | 115    | 115   |       |       |       |       |       | 157     |
| Earl Grey    |        |       | 3,617 |       |       |       |       | 1,018   |
| Elstow       |        |       | 1,553 |       |       |       |       | 1,352   |
| Ebor         |        |       | 455   |       |       |       |       | 72      |
| Engelfeldt   |        |       | 653   |       |       |       |       | 1,400   |
| Esterhazy    | 1,000  |       |       | 2,984 |       | 1,200 |       | 699     |
| Estevan      | 1,080  | 1,309 |       | 1,050 |       |       |       | 1,715   |
| Fairlight    | 1,218  | 128   | 745   |       |       |       |       | 1,425   |
| Fielding     |        |       |       | 292   |       |       |       | 225     |
| Fillmore     |        |       | 2,635 | 668   |       | 1,791 |       | 1,866   |
| Fleming      | 370    |       |       |       |       |       |       | 460     |
| Foam Lake    |        |       | 443   |       |       | 2,228 |       | 174     |
| Forget       | 2,008  | 3,736 | 8,199 | 5,087 |       | 8,038 |       | 200     |
| Francis      |        | 2,072 | 3,864 | 1,050 |       | 200   |       | 1,939   |
| Frobisher    | 3,470  | 2,432 | 2,050 | 807   |       | 1,800 |       | 710     |
| Gainsboro    | 334    |       | 1,000 | 666   |       | 1,788 |       | 250     |
| Girvin       |        |       | 1,480 |       |       |       |       | 318     |
| Glen Ewen    |        |       | 2,930 | 682   |       | 173   |       | 1,582   |
| Govan        |        | 3,900 | 2,826 | 1,404 |       | 1,166 |       | 2,243   |
| Grayson      | 380    | 2,440 | 3,000 | 2,693 |       | 4,986 |       | 3,906   |
| Grenfell     |        |       | 2,064 | 1,048 |       | 1,215 |       | 1,251   |
| Gull Lake    | 972    |       |       |       |       |       |       | 2,160   |
| Hague        |        |       | 106   |       |       |       |       |         |
| Halbrite     | 1,000  |       | 1,670 | 1,400 |       |       |       | 1,325   |
| Hanley       | 637    |       | 1,082 | 261   |       |       |       | 775     |
| Harrowby     |        |       | 610   |       |       |       |       | 604     |
| Herbert      | 506    | 244   | 1,292 |       |       | 1,199 |       | 301     |

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SCHEDULE No. 3.—STATEMENT of Grain Distribution at Railway Stations in  
Saskatchewan—Continued.

| Station.              | WHEAT. |       |       |       | OATS. |       |       |            | Barley. |
|-----------------------|--------|-------|-------|-------|-------|-------|-------|------------|---------|
|                       | 1 Nr.  | 2 Nr. | 3 Nr. | 4 Nr. | 1 Wh. | 2 Wh. | 3 Wh. | Im-ported. |         |
| Heward.....           |        |       | 489   | 1,110 |       | 1,200 |       | 1,052      |         |
| Hirsch.....           | 2,050  | 3,870 | 3,449 |       |       | 2,157 |       | 641        |         |
| Hitchcock.....        |        |       | 605   |       |       |       |       | 245        |         |
| Humboldt.....         |        |       | 2,800 |       |       |       |       | 4,791      | 10      |
| Indian Head.....      |        | 648   | 2,368 |       |       |       |       | 1,973      | 164     |
| Insinger.....         |        |       | 575   |       |       |       |       | 1,200      | 13      |
| Invermay.....         |        | 325   |       |       |       |       |       | 5,441      |         |
| Kaiser.....           |        |       | 1,632 |       |       | 1,239 |       | 1,103      |         |
| Kamsack.....          | 1,050  |       |       | 67    |       |       |       | 9,390      |         |
| Kenaston.....         | 792    |       |       | 1,038 |       |       |       | 1,083      |         |
| Kennedy.....          |        |       |       | 850   |       |       |       | 483        |         |
| Killaly.....          |        | 516   | 1,112 |       |       |       |       | 1,798      |         |
| Kinistino.....        |        | 310   |       |       |       |       |       | 610        |         |
| Kisbey.....           |        |       | 1,314 | 3,010 |       |       |       | 1,952      |         |
| Kronau.....           |        |       | 100   |       |       | 1,320 |       | 548        |         |
| Kuroki.....           |        | 24    | 92    |       |       |       |       | 1,775      | 158     |
| Lang.....             |        |       | 229   |       |       |       |       | 899        |         |
| Langenburg.....       | 1,597  | 996   | 692   | 1,573 |       | 7,989 |       | 1,205      | 682     |
| Langham.....          |        |       | 202   | 129   |       |       |       | 170        |         |
| Lanigan.....          | 2,234  |       | 1,609 |       |       | 3,600 |       | 2,490      | 900     |
| Lashburn.....         | 846    | 954   | 796   |       |       | 2,314 |       | 2,348      | 588     |
| Lenberg.....          | 1,116  |       | 1,060 | 758   |       | 128   |       | 2,646      |         |
| Lipton.....           | 3,503  | 1,040 | 5,126 | 2,086 |       | 1,839 |       | 8,312      |         |
| Lockwood.....         | 1,050  |       | 127   |       |       |       |       | 674        |         |
| Lloydminster.....     | 1,070  |       | 2,280 | 1,000 |       | 3,621 |       | 9,712      | 2,705   |
| Lumsden.....          |        |       | 1,624 | 978   |       |       |       | 610        |         |
| Macoun.....           | 2,086  | 1,314 | 4,029 | 998   |       | 3,555 |       | 192        | 594     |
| Maidstone.....        |        |       | 1,239 |       |       |       |       | 1,767      | 147     |
| Manor.....            |        | 975   | 3,379 | 1,105 |       | 1,800 |       | 1,329      |         |
| Maple Creek.....      |        |       |       |       |       |       |       | 202        |         |
| Marshall.....         |        |       | 566   | 999   |       |       |       | 1,885      | 524     |
| Marchwell.....        |        |       | 1,394 |       |       | 1,800 |       | 654        |         |
| Margo.....            |        | 34    |       |       |       |       |       | 1,200      | 101     |
| Maymont.....          |        |       | 968   | 75    |       |       |       | 514        |         |
| Melfort.....          |        |       | 1,050 |       |       |       |       | 2,965      |         |
| Midale.....           | 148    | 852   | 1,592 |       |       |       |       | 1,547      |         |
| Milestone.....        |        |       | 1,475 |       |       | 2,949 |       |            |         |
| Moosejaw.....         |        |       | 1,050 |       |       | 1,701 |       | 320        |         |
| Moosomin.....         |        |       | 1,970 |       |       |       |       | 897        | 210     |
| Morse.....            |        |       | 1,032 |       |       | 1,800 |       | 618        | 110     |
| Mortlach.....         | 1,058  |       | 1,020 | 1,732 |       | 3,597 |       | 2,984      | 402     |
| Muenster.....         |        |       | 2,160 |       |       | 2,607 |       | 1,512      | 440     |
| McDowell.....         |        |       |       |       |       |       |       | 236        |         |
| McLean.....           |        | 1,050 | 366   |       |       |       |       | 1,540      | 140     |
| McTaggart.....        |        |       | 490   |       |       |       |       | 180        |         |
| Neudorf.....          |        | 214   | 786   | 1,050 |       | 800   |       | 177        |         |
| Nokomis.....          | 2,138  | 596   | 1,058 |       |       | 3,270 |       |            |         |
| North Battleford..... |        |       |       | 977   |       |       |       | 1,194      |         |
| North Portal.....     |        |       | 120   |       |       |       |       | 200        |         |
| Oreadia.....          |        |       | 260   |       |       | 3,379 |       | 1,500      | 70      |
| Osage.....            |        | 3,100 | 912   |       |       |       |       | 1,897      |         |
| Osher.....            |        | 55    |       |       |       |       |       | 104        |         |
| Oxbow.....            | 1,306  |       | 1,298 | 440   |       |       |       | 1,078      |         |
| Parkbeg.....          |        |       | 240   |       |       |       |       | 120        | 10      |
| Pasqua.....           |        |       | 462   |       |       |       |       | 630        |         |
| Paynton.....          |        | 956   |       |       |       |       |       | 1,413      | 119     |
| Pense.....            |        |       |       |       |       |       |       | 80         |         |
| Pilot Butte.....      |        |       | 95    |       |       |       |       | 320        | 50      |
| Prince Albert.....    |        | 55    |       |       |       |       |       | 405        |         |
| Qu'Appelle.....       |        | 932   | 1,816 |       |       | 1,158 |       | 757        | 390     |
| Quill Lake.....       |        |       | 747   |       |       | 1,903 |       | 3,032      | 692     |
| Radisson.....         | 1,100  |       | 1,051 | 520   |       |       |       | 756        |         |
| Redvers.....          | 2,340  | 1,970 | 3,003 | 1,000 |       | 3,651 |       | 1,800      | 1,050   |
| Regina.....           |        | 970   | 4,436 | 1,100 |       |       |       | 4,354      |         |
| Rocanville.....       |        |       | 528   |       |       |       |       | 462        |         |
| Roche Perceé.....     |        |       | 25    |       |       |       |       | 78         | 50      |



## SESSIONAL PAPER No. 25

SCHEDULE No. 3.—STATEMENT of Grain Distribution at Railway Stations in Saskatchewan—*Continued.*

| Station.            | WHEAT. |        |         |        | OATS. |         |       |            | Barley. |
|---------------------|--------|--------|---------|--------|-------|---------|-------|------------|---------|
|                     | 1 Nr.  | 2 Nr.  | 3 Nr.   | 4 Nr.  | 1 Wh. | 2 Wh.   | 3 Wh. | Im-ported. |         |
| Rokeby .....        |        |        |         | 324    |       | 5,895   |       | 3,620      | 211     |
| Rouleau .....       | 917    | 1,050  |         |        |       |         |       | 1,419      |         |
| Rush Lake .....     |        |        | 100     |        |       |         |       | 300        |         |
| Salcoats .....      |        | 1,878  | 2,996   | 1,026  |       | 13,153  |       | 9,639      | 716     |
| Saskatoon .....     | 1,986  |        | 1,025   | 958    |       |         |       | 3,782      |         |
| Sedley .....        |        |        | 2,860   |        |       |         |       | 2,521      |         |
| Shebo .....         | 1,438  |        | 13      |        |       | 3,600   |       | 4,352      | 598     |
| Sintaluta .....     |        |        | 1,052   |        |       |         |       | 330        | 100     |
| Southey .....       |        | 687    | 532     | 768    |       | 2,297   |       | 44         |         |
| Springside .....    |        |        | 372     |        |       | 1,810   |       | 3,168      | 235     |
| Star City .....     | 653    |        | 644     |        |       |         |       | 4,003      |         |
| St. Gregor .....    |        |        | 475     |        |       |         |       | 775        | 38      |
| Stockholm .....     |        | 996    | 159     |        |       |         |       | 1,565      | 2       |
| Stoughton .....     | 1 050  | 1,024  | 4,866   | 1,556  |       | 3,750   |       | 1,926      |         |
| Strassburg .....    |        |        | 1,319   |        |       | 430     |       | 289        |         |
| Swift Current ..... |        | 3,124  | 2,230   |        |       | 3,410   |       | 4,186      |         |
| Summerberry .....   |        |        |         |        |       |         |       | 78         | 180     |
| Tantallon .....     |        |        | 535     |        |       |         |       | 562        |         |
| Theodore .....      |        | 979    | 138     |        |       | 2,578   |       | 5,365      | 103     |
| Tiny .....          |        | 72     |         |        |       |         |       | 2,280      |         |
| Tisdale .....       | 177    |        | 1,050   | 110    |       | 1,800   |       | 3,069      |         |
| Togo .....          |        | 1,760  |         |        |       | 1,911   |       | 6,395      |         |
| Tuxford .....       | 302    |        | 974     | 1,778  |       |         |       | 1,842      | 155     |
| Tyvan .....         |        |        | 1,976   | 2,028  |       |         |       | 875        |         |
| Verigin .....       |        |        |         | 1,428  |       |         |       | 8,321      |         |
| Vonda .....         |        | 982    | 1,131   |        |       |         |       | 1,583      |         |
| Wadena .....        | 674    |        | 2,093   | 7,164  |       |         |       | 14,982     | 1,240   |
| Walpole .....       |        |        | 655     |        |       |         |       | 805        |         |
| Wapella .....       |        | 4      | 1,576   | 1,209  |       |         |       | 1,212      | 241     |
| Warman .....        |        |        |         | 145    |       |         |       | 696        |         |
| Watson .....        | 972    | 1,448  | 2,110   | 368    |       | 517     |       | 7,213      |         |
| Wauchope .....      | 1,048  | 1,030  | 2,010   | 1,000  |       | 1,909   |       | 2,383      |         |
| Wawota .....        |        |        | 300     |        |       |         |       | 325        |         |
| Welwyn .....        |        |        | 470     |        |       |         |       | 330        |         |
| Weyburn .....       | 1,002  |        | 4,215   |        |       |         |       | 2,843      |         |
| Whitewood .....     |        | 1,090  | 1,137   | 222    |       | 1,530   |       | 155        | 170     |
| Windthorst .....    | 1,658  |        | 5,880   | 3,698  |       | 3,693   |       | 3,014      | 1,271   |
| Wolseley .....      |        |        | 2,000   | 1,100  |       | 2,400   |       | 255        | 465     |
| Yellow Grass .....  | 196    | 2,140  | 1,668   |        |       | 3,026   |       | 470        |         |
| Yorkton .....       | 398    | 1,362  | 2,212   |        |       | 30,711  |       | 9,520      | 902     |
| Total .....         | 66,013 | 74,668 | 229,596 | 87,289 | 425   | 202,873 | 1,056 | 333,492    | 24,154  |

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## SCHEDULE No. 4.—AMOUNT of Grain Distributed at Railways Stations in Alberta.

| Station.               | WHEAT. |       |       |       | OATS. |       |       |            | Barley. |
|------------------------|--------|-------|-------|-------|-------|-------|-------|------------|---------|
|                        | 1 Nr.  | 2 Nr. | 3 Nr. | 4 Nr. | 1 Wh. | 2 Wh. | 3 Wh. | Im-ported. |         |
| Airdrie.....           |        |       | 25    |       |       |       |       | 572        | 50      |
| Alix.....              |        |       | 9     |       |       | 558   |       | 120        | 306     |
| Bawlf.....             |        | 314   | 394   |       |       | 675   | 1,866 | 1,352      |         |
| Bassano.....           |        |       |       |       |       | 60    |       |            |         |
| Blackfalds.....        |        |       | 8     |       |       | 270   |       |            | 62      |
| Bowden.....            |        |       | 289   |       |       | 1,920 |       | 1,645      | 351     |
| Bow Island.....        | 60     |       |       |       |       | 110   |       |            |         |
| Bruderheim.....        |        |       |       |       |       |       |       | 115        |         |
| Calgary.....           |        |       | 44    |       |       |       |       | 2,709      | 378     |
| Camrose.....           |        | 522   |       |       |       | 1,634 |       | 1,858      | 740     |
| Camrose.....           |        |       |       |       |       |       |       | 251        |         |
| Cardston.....          |        | 55    |       |       | 116   |       |       |            |         |
| Carstairs.....         |        |       | 64    |       |       |       |       | 2,001      | 120     |
| Cayley.....            |        |       |       |       |       |       |       | 1,822      |         |
| Chipman.....           |        |       | 8     |       |       |       |       | 120        | 14      |
| Clareholm.....         | 470    |       |       |       |       | 265   |       |            |         |
| Cochrane.....          |        |       | 75    |       |       | 1,200 |       | 25         |         |
| Coleridge.....         | 46     |       |       |       |       | 125   |       | 1,781      | 401     |
| Cowley.....            |        | 95    |       |       |       | 736   |       |            |         |
| Crossfield.....        | 100    |       | 65    |       |       |       |       | 700        | 160     |
| Daysland.....          | 1,060  | 776   |       |       |       | 810   |       | 2,526      | 512     |
| Didsbury.....          |        |       | 202   |       |       | 1,800 |       | 1,200      | 854     |
| Edmonton.....          |        |       | 500   |       |       |       |       | 3,590      | 353     |
| Fort Saskatchewan..... | 524    |       |       |       |       |       |       | 4,832      | 748     |
| Gleichen.....          |        |       | 30    |       |       | 85    |       | 100        |         |
| Granum.....            |        | 120   |       |       |       | 1,690 |       | 12         |         |
| Grassy Lake.....       | 15     |       |       |       |       | 10    |       |            |         |
| Hardisty.....          |        |       | 522   |       |       |       |       | 3,201      | 200     |
| High River.....        |        | 680   |       |       |       | 8,639 |       | 774        |         |
| Innisfail.....         |        |       | 680   |       |       | 8,466 |       | 149        | 1,789   |
| Islay.....             |        |       | 1,122 |       |       |       |       | 4,000      | 461     |
| Innisfree.....         |        |       | 1,122 |       |       | 1,800 |       | 267        | 258     |
| Irvine.....            | 442    |       |       |       |       | 717   |       | 10         |         |
| Killam.....            |        | 306   | 710   |       |       | 582   | 1,200 |            | 180     |
| Kitscoty.....          |        |       | 880   |       |       |       |       | 1,605      | 242     |
| Lacombe.....           |        |       | 165   |       |       | 2,766 |       | 175        | 648     |
| Lauont.....            |        |       | 304   |       |       |       |       | 2,702      | 404     |
| Lavoy.....             |        |       | 154   |       |       |       |       | 1,507      | 145     |
| Langdon.....           |        |       |       |       |       | 770   |       | 698        | 30      |
| Leduc.....             | 178    |       |       |       |       |       |       | 11,591     | 1,188   |
| Lloydminster.....      |        |       |       |       |       |       |       | 64         |         |
| Longhead.....          |        |       |       |       |       |       |       | 28         |         |
| Lethbridge.....        |        | 72    |       |       |       | 208   |       |            |         |
| Manville.....          |        |       | 537   | 894   |       |       |       | 5,089      | 613     |
| Medicine Hat.....      |        | 712   |       |       |       |       |       | 1,467      |         |
| Millet.....            | 180    |       |       |       |       | 1,399 |       | 1,330      |         |
| Midnapore.....         |        |       |       |       |       |       |       | 78         |         |
| Morinville.....        |        |       | 5,372 |       |       |       |       | 1,699      | 569     |
| Morley.....            |        |       |       |       |       |       |       | 199        |         |
| Morningside.....       |        |       | 35    |       |       | 915   |       | 20         | 216     |
| Mundare.....           |        |       | 280   |       |       |       |       | 1,132      | 111     |
| Macleod.....           |        | 430   |       |       |       | 160   |       |            |         |
| Nanton.....            | 250    | 100   |       |       |       | 2,858 |       | 475        |         |
| Olaton.....            |        | 360   |       |       |       | 1,249 |       | 1,219      | 365     |
| Okotoks.....           |        | 10    |       |       |       | 403   |       | 502        |         |
| Olds.....              |        |       | 199   |       |       | 1,842 |       | 4,388      | 660     |
| Penhold.....           |        |       | 14    |       |       |       |       | 568        | 139     |
| Ponoka.....            |        | 332   |       |       |       | 1,716 | 1,893 | 5,761      | 1,250   |
| Pincher.....           |        |       |       |       |       |       |       | 10         |         |
| Ranfurley.....         |        |       | 105   |       |       | 380   |       | 455        | 20      |
| Red Deer.....          |        | 700   |       |       |       | 1,906 |       | 3,354      | 668     |
| Sedgewick.....         |        | 301   |       |       |       | 764   |       | 40         | 112     |
| St. Albert.....        |        |       | 55    |       |       |       |       | 3,928      | 24      |
| Sheppard.....          | 446    |       |       |       |       | 855   |       |            |         |
| Stettler.....          |        | 214   | 786   |       |       |       |       | 1,289      | 759     |
| Stony Plain.....       |        |       | 313   |       |       |       |       | 1,240      | 156     |
| Strathcona.....        |        |       | 128   |       |       | 677   |       | 3,865      | 1,086   |

## SESSIONAL PAPER No. 25

SCHEDULE No. 4.—AMOUNT of Grain Distributed at Railways Stations in Alberta—  
*Continued.*

| Station.        | Wheat. |       |        |       | Oats. |        |       |            | Barley. |
|-----------------|--------|-------|--------|-------|-------|--------|-------|------------|---------|
|                 | 1 Nr.  | 2 Nr. | 3 Nr.  | 4 Nr. | 1 Wh. | 2 Wh.  | 3 Wh. | Im-ported. |         |
| Staveley.....   |        |       |        |       |       | 302    |       |            |         |
| Taber.....      | 129    |       |        |       |       | 174    |       |            |         |
| Strathmore..... |        |       | 98     |       |       | 385    |       |            |         |
| Tees.....       |        |       | 28     |       |       | 1,768  |       |            | 185     |
| Vegreville..... |        |       | 936    |       |       |        |       | 4,746      | 517     |
| Vermillion..... | 1,000  |       | 1,626  |       | 345   | 1,458  |       | 8,922      | 1,742   |
| Walsh.....      | 160    |       |        |       |       | 185    |       |            |         |
| Wetaskiwin..... | 686    |       |        |       | 1,932 | 5,031  | 2,898 | 1,904      | 1,110   |
| Total.....      | 5,746  | 6,099 | 17,984 | 894   | 2,393 | 60,323 | 7,848 | 110,522    | 20,886  |

## SCHEDULE No. 5.—STATEMENT showing total Grain Distributed in Saskatchewan and Alberta.

| Province.         | WHEAT. |        |         |        | OATS. |         |       |            | Barley. |
|-------------------|--------|--------|---------|--------|-------|---------|-------|------------|---------|
|                   | 1 Nr.  | 2 Nr.  | 3 Nr.   | 4 Nr.  | 1 Wh. | 2 Wh.   | 3 Wh. | Im-ported. |         |
| Saskatchewan..... | 66,013 | 74,668 | 229,506 | 87,282 | 425   | 202,873 | 1,056 | 333,492    | 24,154  |
| Alberta.....      | 5,746  | 6,099  | 17,984  | 894    | 2,393 | 60,323  | 7,848 | 110,522    | 20,886  |
| Total.....        | 71,759 | 80,767 | 247,490 | 88,176 | 2,818 | 263,196 | 8,904 | 444,014    | 45,040  |

|                  |           |
|------------------|-----------|
| Total wheat..... | 488,192   |
| " oats.....      | 718,932   |
| " " barley.....  | 45,040    |
|                  | 1,252,164 |

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## A.—DOMINION Land Agencies, principal transactions

| Agencies.             | Homestead Entries granted. | LAND SALES |                |                        | Applications for Patent Received. | Land Entries Cancelled. | Timber Permits Issued. | Hay Permits Issued. |
|-----------------------|----------------------------|------------|----------------|------------------------|-----------------------------------|-------------------------|------------------------|---------------------|
|                       |                            | Ordinary.  | Pre-emp-tions. | Purchased Home-steads. |                                   |                         |                        |                     |
| Battleford .....      | 3,371                      | 25         | 863            | 138                    | 1,806                             | 1,755                   | 356                    | 110                 |
| Brandon .....         | 171                        |            |                |                        | 324                               | 53                      | 460                    | 26                  |
| Calgary .....         | 2,798                      | 263        | 1,826          | 115                    | 1,349                             | 715                     | 677                    | 135                 |
| Dauphin .....         | 1,729                      | 33         |                |                        | 386                               | 329                     | 1,432                  | 90                  |
| Edmonton .....        | 5,242                      | 53         | 49             | 3                      | 2,070                             | 2,137                   | 1,853                  | 262                 |
| Estevan .....         | 840                        | 89         | 911            | 57                     | 1,028                             | 342                     | 324                    | 283                 |
| Humboldt .....        | 2,421                      | 28         | 61             | 16                     | 2,618                             | 1,126                   | 415                    | 60                  |
| Kamloops .....        | 400                        | 59         |                |                        | 83                                | 70                      |                        | 9                   |
| Lethbridge .....      | 3,820                      | 209        | 2,656          | 71                     | 1,201                             | 1,290                   | 402                    | 124                 |
| Moose-jaw .....       | 8,720                      | 338        | 7,227          | 249                    | 1,988                             | 2,988                   | 756                    | 429                 |
| New Westminster...    | 32                         | 13         |                |                        | 30                                |                         |                        |                     |
| Prince Albert.....    | 2,079                      | 42         | 57             | 52                     | 863                               | 755                     | 1,357                  | 176                 |
| Red Deer.....         | 2,080                      | 54         | 128            | 22                     | 1,042                             | 1,109                   | 423                    | 28                  |
| Regina .....          | 1,536                      | 90         | 438            | 107                    | 2,743                             | 737                     | 315                    | 254                 |
| Winnipeg .....        | 1,865                      | 72         |                |                        | 300                               | 468                     | 1,185                  | 267                 |
| Yorkton.....          | 2,183                      | 99         |                |                        | 1,462                             | 963                     | 568                    | 89                  |
|                       | 39,217                     | 1,467      | 14,207         | 830                    | 19,293                            | 14,837                  | 10,523                 | 2,342               |
| Compared with 1907-8. | 37,855                     | 1,112      |                |                        | 11,948                            | 17,370                  | 8,333                  | 1,490               |
| Compared with 1906-7. | 30,472                     | 731        |                |                        | 16,364                            | 17,612                  | 10,806                 | 2,046               |

## SESSIONAL PAPER No. 25

for the Departmental Year ending March 31, 1909.

| LETTERS   |         | REVENUE.  |                      | No. of Staff. | EXPENDITURE. |                |
|-----------|---------|-----------|----------------------|---------------|--------------|----------------|
| Received. | Sent.   | Scrp.     | Total Scrp and Cash. |               | Salaries.    | Disbursements. |
|           |         | \$ cts.   | \$ cts.              |               | \$ cts.      | \$ cts.        |
| 34,641    | 31,199  | 480 00    | 82,351 62            | 10            | 8,905 00     | 1,681 04       |
| 9,304     | 8,188   | 934 81    | 26,127 71            | 4             | 3,749 94     | 175 93         |
| 34,740    | 34,196  | 2,080 00  | 132,895 12           | 13            | 13,253 20    | 2,866 99       |
| 21,447    | 12,056  | 80 00     | 34,301 01            | 4             | 4,079 92     | 805 42         |
| 56,007    | 45,229  | .....     | 87,532 48            | 25            | 16,381 68    | 2,143 54       |
| 13,887    | 12,125  | .....     | 35,147 85            | 5             | 4,798 42     | 426 91         |
| 30,880    | 31,081  | .....     | 35,052 89            | 7             | 4,957 29     | 2,176 70       |
| 4,400     | 3,876   | 1,394 89  | 19,766 27            | 3             | 3,394 96     | 214 79         |
| 31,574    | 24,962  | .....     | 148,560 52           | 7             | 6,174 96     | 1,767 16       |
| 60,766    | 77,000  | 6,794 25  | 233,735 67           | 22            | 13,861 97    | 5,489 96       |
| 2,923     | 2,614   | 80 00     | 2,863 43             | 2             | 2,194 96     | 322 85         |
| 15,442    | 12,706  | 880 00    | 75,651 57            | 6             | 5,644 93     | 2,017 91       |
| 18,525    | 17,127  | .....     | 38,400 31            | 6             | 5,774 98     | 871 19         |
| 37,489    | 34,660  | .....     | 67,637 06            | 13            | 12,092 76    | 1,231 95       |
| 24,382    | 22,130  | 3,837 36  | 127,949 83           | 14            | 15,428 00    | 3,113 70       |
| 29,766    | 22,099  | .....     | 39,812 29            | 7             | 6,479 88     | 611 89         |
| 426,173   | 391,248 | 16,561 31 | 1,187,785 63         | 148           | 129,172 85   | 25,917 93      |
| 378,556   | 292,881 | 4,280 61  | 829,211 33           | 132           | 96,251 78    | 18,220 02      |
| 373,911   | 329,444 | 7,648 15  | 773,222 65           | 124           | 112,887 48   | 22,073 60      |

R. E. A. LEECH,  
Inspector of Dominion Lands Agencies.



## SESSIONAL PAPER No. 25

|                     | 142    | 12    | 3     | 79    | 11    | 1,791 93   | 600 00    | 14 52    |                                      |
|---------------------|--------|-------|-------|-------|-------|------------|-----------|----------|--------------------------------------|
| Malcolm, H. A.      |        |       |       |       |       |            |           |          | Appointed March 1, 1909.             |
| Marshall, W. A.     | 1,217  | 134   | 177   | 105   | 135   | 15,523 25  | 325 00    | 86 23    |                                      |
| McBurn, Wm.         | 612    | 171   | 125   | 88    | 33    | 9,285 80   | 600 00    | 55 37    |                                      |
| McDonald, G.        | 83     | 27    | 26    | 50    | 13    | 890 20     | 250 00    | 5 58     | Appointed Hmsld. Insp. May 22, 1909. |
| McDonald, J. S.     | 593    | 320   | 314   | 8     | 9     | 8,292 70   | 300 00    | 51 91    |                                      |
| McGregor, A. B.     | 211    | 147   | 137   | 4     | 21    | 3,136 20   | 292 67    | 27 86    | Resigned Sept. 17, 1908.             |
| Robertson, A. J.    | 268    | 403   | 74    | 15    |       | 3,768 25   | 215 95    | 33 21    | Began Sept. 8, 1908.                 |
| McGregor, D. S.     | 633    | 169   | 106   | 104   | 98    | 15,701 39  | 600 00    | 57 91    |                                      |
| McIntosh, R.        | 2,214  | 883   | 727   | 4     | 91    | 39,745 40  | 1,050 00  | 179 28   |                                      |
| MacKenzie W. L.     | 223    | 345   | 90    | 78    | 16    | 2,363 40   | 300 00    | 40 81    |                                      |
| McKernan, Jas.      | 100    | 2     | 4     | 9     | 20    | 1,613 66   | 300 00    | 9 25     |                                      |
| Newth, R.           | 305    | 330   | 222   | 6     | 19    | 3,690 00   | 480 00    | 48 96    |                                      |
| Orange, Geo         | 441    | 150   | 109   | 60    | 29    | 5,216 25   | 600 00    | 46 19    |                                      |
| Oxley, R. W.        | 615    | 398   | 230   |       | 24    | 17,484 70  | 600 00    | 81 67    |                                      |
| Palmer, T.          | 55     | 9     |       |       | 10    | 688 68     | 180 00    |          |                                      |
| Paine, S. B.        | 27     | 38    | 19    |       |       | 261 50     | 300 00    | 8 60     |                                      |
| Reed, C. C.         | 144    | 90    | 68    | 26    | 9     | 2,361 92   | 300 00    | 25 66    |                                      |
| Roberts, A.         | 21     | 16    | 13    |       | 15    | 650 76     | 300 00    | 3 74     |                                      |
| Robertson, Wm.      | 492    | 365   | 160   | 16    | 11    | 7,083 75   | 430 00    | 51 91    |                                      |
| Spence, Chas. T.    | 224    | 169   | 107   | 24    | 11    | 2,375 25   | 50 00     | 21 93    | Resigned Feb. 4, 1909.               |
| Goodwin, A. H.      | 29     | 36    | 15    | 3     | 3     | 342 30     | 50 00     | 3 79     | Appointed Feb. 4, 1909.              |
| Stedman, E. F.      | 104    | 187   | 78    |       | 7     | 1,155 30   | 125 00    | 11 95    | Resigned Sept. 1, 1908.              |
| Stephen, A. M.      | 12     | 153   | 35    |       |       | 1,475 50   | 480 00    | 7 19     |                                      |
| Stewart, Robt.      | 174    | 75    | 18    | 97    | 10    | 1,223 80   | 420 00    | 15 79    |                                      |
| Taylor, Robert      | 26     | 116   | 28    | 3     | 13    | 383 95     | 480 00    | 9 13     |                                      |
| Tompkins, P.        | 59     | 7     | 4     | 32    | 12    | 820 67     | 1,500 00  | 1 11     |                                      |
| Vickerson, F.       | 180    | 74    | 85    | 46    | 23    | 2,478 05   | 450 00    | 20 69    |                                      |
| Wachna, Theo.       | 100    | 19    | 6     | 168   | 17    | 1,257 19   | 300 00    | 8 32     |                                      |
| Waddell, A.         | 150    | 186   | 105   | 10    | 27    | 2,171 30   | 250 00    | 11 30    | Resigned September 3, 1908.          |
| Wetheral, F. E.     | 704    | 391   | 96    | 2     | 28    | 15,365 00  | 325 00    | 48 27    | Began "                              |
| Ward, D. A.         | 157    | 55    | 99    | 18    | 16    | 2,037 10   | 600 00    | 13 45    |                                      |
| Wiebe, J. F.        | 740    | 89    | 45    | 106   | 88    | 8,737 45   | 350 00    | 55 36    |                                      |
| Wild, A. E.         | 428    | 239   | 70    | 117   | 17    | 4,604 25   | 600 00    | 38 64    |                                      |
| Wilson, H. G. W.    | 37     | 44    | 28    | 7     | 1     | 474 00     | 300 00    | 8 38     |                                      |
|                     | 19,422 | 9,057 | 5,449 | 3,080 | 1,387 | 290,053 92 | 25,296 32 | 1,829 95 |                                      |
| Compared with 1908. | 13,380 | 6,875 | 8,524 | 3,543 | 1,258 | 175,541 16 | 24,474 07 | 1,515 44 |                                      |
| "                   | 18,627 | 6,267 | 6,400 | 2,786 | 900   | 225,697 80 | 20,428 55 | 1,512 11 |                                      |

R. E. A. LEECH,  
Inspector of Dominion Lands Agencies.

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C.—HOMESTEAD INSPECTORS Statement, showing principal work performed during the Departmental Year ended March 31, 1909.

| Name.             | Headquarters.        | Land Inspections made. | Applications taken. | Miles travelled by Wagon. | Miles by travelled by Reil. | Travelling and living Expenses for Self and Team. | Expenses for new and old travelling Equipment. | Remarks.  |
|-------------------|----------------------|------------------------|---------------------|---------------------------|-----------------------------|---|--|---|
|                   |                      |                        |                     | \$ cts.                   | \$ cts.                     | \$ cts.   | \$ cts.  |   |
| Axford, Fred.     | Glenboro, Man.       | 253                    | 110                 | 4,402                     | 3,024                       | 1,015 21  | 89 25  | 3 months' seed grain; no report (Dec. to March); assistant inspector. |
| Bannerman, J. A.  | Red Deer, Alta.      | 678                    | 3                   | 1,914                     | 8,691                       | 691 65  |  | Resigned August 1, 1908.  |
| Bell, Geo. A.     | Estevan, Sask.       | 111                    | 41                  | 1,272                     | 1,371                       | 364 85  | 91 85  | 2 months' seed grain.   |
| Bowtell, H.       | Vermilion, Alta.     | 447                    | 203                 | 7,184                     | 2,669                       | 1,665 80  | 29 37  | Appointed January 29, 1909.   |
| Brinkmier, J. A.  | Dead Moose Lake      | 74                     | 60                  | 827                       | 1,599                       | 980 61  |  | 2 months' seed grain.   |
| Brooke, A. W.     | Moosejaw, Sask.      | 327                    | 352                 | 2,518                     | 1,234                       | 762 25  | 54 65  | 2 months' seed grain.   |
| Bryant, T. W.     | Calgary, Alta.       | 103                    | 43                  | 1,417                     | 647                         | 366 65  | 33 20  | 2 months' seed grain; 1/2 month Land Office assistant agent.          |
| Buchanan, D.      | Mimisdosa, Man.      | 256                    | 223                 | 4,679                     | 2,799                       | 997 85  | 26 50  | 1 month's seed grain.   |
| Budgeon, M. B.    | Prince Albert, Sask. | 7                      | 99                  | 99                        | 500                         | 21 70   | 5 25   | Appointed March 18, 1909.   |
| Clanston, Geo. H. | Battleford, Sask.    | 258                    | 209                 | 4,728                     | 1,417                       | 679 09  | 117 75   |   |
| Coulter, R. J.    |                      | 12                     |                     | 189                       | 400                         | 38 40   |  |   |
| Cunningham, T. J. | Vegreville, Alta.    | 197                    | 253                 | 3,265                     | 2,327                       | 1,000 09  | 58 40  | 1 month's work, February, 1909.                                       |
| Currie, A. B.     | Kamloops, B. C.      | 593                    | 117                 | 2,531                     | 7,184                       | 1,110 35  |  | 2 months' seed grain.   |
| Darrock, E. J.    | Swan River, Man.     | 92                     | 17                  | 1,865                     | 1,692                       | 480 72  | 2 00   | 11 months' work; no March report.                                     |
| Dodds, J. T.      | Swift Current, Sask. | 562                    | 245                 | 4,524                     | 5,988                       | 1,016 38  | 34 00  | Appointed July 25, 1908.  |
| Doggan, J. S.     | Pakan, Alta.         | 146                    | 91                  | 4,461                     | 835                         | 1,046 90  | 10 75  | 2 months' seed grain.   |
| Duggan, L. H.     | Humboldt, Sask.      | 224                    | 30                  | 2,453                     | 3,013                       | 1,059 61  | 8 75   | " "   |
| Gibson, J. S.     | Braudton, Man.       | 293                    | 74                  | 2,121                     | 6,360                       | 557 91  | 3 60   | " "   |
| Gladstone, W. E.  | Prince Albert, Sask. | 133                    | 115                 | 2,042                     | 3,295                       | 691 45  | 28 50  | " " Resigned February 28, 1909.                                       |
| Grayson, Chas.    | Cochrane, Alta.      | 68                     | 20                  | 534                       | 595                         | 150 45  | 14 95  | Appointed January 30, 1909.   |
| Hehner, A.        | Calgary, Alta.       | 1,869                  | 3                   | 5,796                     | 11,592                      | 1,927 35  |  | Combined statistics; 4 months' seed grain.                            |
| Robertson, S. N.  |                      |                        |                     |                           |                             |   |  |   |
| Jonasson, P.      | Winnipeg, Man.       | 192                    | 84                  | 2,595                     | 1,818                       | 1,147 80  | 192 20   | 2 months' seed grain.   |
| Kennedy, F.       | White-wood, Sask.    | 208                    | 301                 | 4,389                     | 3,526                       | 976 85  | 40 00  | 2 months' seed grain.   |
| Lagimodiere, Win. | Winnipeg, Man.       | 287                    | 65                  | 3,362                     | 1,621                       | 1,228 50  | 258 50   |   |
| Loewner, J. E.    | Lethbridge, Alta.    |                        |                     |                           |                             |   |  |   |
| Loak, Adam.       | Lethbridge, Alta.    | 639                    | 310                 | 4,213                     | 1,159                       | 1,127 90  | 212 85   | Appointed March 25, 1909.   |
| Magee, W. D.      | Lamerton, Alta.      | 305                    | 173                 | 5,305                     | 1,803                       | 850 80  | 30 50  | 1 month's seed grain.   |
| Moffat, Jas.      | Marcelin, Sask.      | 159                    | 291                 | 3,220                     | 637 62                      | 637 62  | 29 25  | Resigned September 30, 1908.  |
| MacDonald, G.     | Belfvedere, Alta.    | 111                    | 11                  | 1,133                     | 2,003                       | 200 35  | 13 00  | Appointed January 29, 1909.   |
| McCallum, N. G.   | Yorkton, Sask.       |                        |                     |                           | 388                         | 21 45   |  | 1 month's seed grain; appointed to Land Office.                       |



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|                     |        |       |         |         |           |                      |                                      |
|---------------------|--------|-------|---------|---------|-----------|----------------------|--------------------------------------|
| McCarthy, D. J.     | 116    | 212   | 3,411   | 2,865   | 1,065 65  | 151 40               | 2 months' seed grain.                |
| McDiarmid, D. J.    | 17     | 27    | 435     | 382 45  | 382 45    | 18 55                | 2½ months' seed grain, ill 7 months. |
| McGregor, R. E.     | 74     | 110   | 2,502   | 1,511   | 685 08    | 53 30                |                                      |
| McLeod, A.          | 380    | 224   | 4,550   | 2,185   | 864 36    | 182 90               | 2 months' seed grain.                |
| McLeod, D.          | 434    | 171   | 4,830   | 2,359   | 776 83    | 65 25                | 11 months' work.                     |
| McNab, D. C.        | 2      | 11    | 11      | 886     | 26 75     | 39 95                | 3 months; resigned July 1, 1908.     |
| Nichol, W. F.       | 245    | 255   | 3,097   | 4,953   | 1,036 53  | 304 00               | 2 months' seed grain.                |
| O'Connor, J.        | 30     | 12    | 597     | 485     | 426 73    | 107 00               | Appointed January 15, 1909.          |
| Oliver, Ed.         | 222    | 166   | 3,069   | 2,205   | 972 63    | 22 10                | 2 months' seed grain.                |
| Pentland, R. F.     | 159    | 147   | 2,955   | 1,197   | 701 72    | 22 10                | "                                    |
| Robinson, E.        | 23     | 6     | 433     | 184     | 59 95     | 23 days' seed grain. | Appointed February 13, 1909.         |
| Seale, John.        | 9      | 11    | 330     | 1,305   | 189 75    | 222 50               | Appointed January 30, 1909.          |
| Shandro, Andrew.    | 3      | 16    | 585     | 244     | 222 50    | 12 75                | 1 month's seed grain.                |
| Skene, Alex.        | 252    | 620   | 5,126   | 2,171   | 681 22    | 60 35                | Resigned March 4, 1909.              |
| Stautfer, J. E.     | 359    | 289   | 3,188   | 4,529   | 811 85    | 83 10                | 2 months, 11 days' seed grain.       |
| Sutton, C.          | 768    | 562   | 5,469   | 1,089   | 1,031 90  | 21 50                | 2 months' seed grain.                |
| Vollmer, F. J.      | 156    | 200   | 2,065   | 1,755   | 643 55    | 24 50                |                                      |
| Williamson, C. R.   | 281    | 296   | 3,135   | 979     | 773 85    | 12 00                | Began May 4, 1908, 4 months' work.   |
| White, M.           | 50     | 16    | 1,635   | 1,198   | 562 05    | 2,553 72             |                                      |
|                     | 12,184 | 6,754 | 130,471 | 111,128 | 33,562 31 | 4,770 04             |                                      |
|                     |        |       |         |         |           | 1,629 15             |                                      |
| Compared with 1908. | 15,476 | 6,281 | 150,553 | 111,378 | 36,641 51 |                      |                                      |
| "                   | 39,679 | 4,338 | 118,828 | 71,560  | 26,940 79 |                      |                                      |

R. E. A. LEECH,  
Inspector of Dominion Lands Agencies.

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## No. 4.

## REPORT OF THE AGENT AT BATTLEFORD.

DOMINION LANDS OFFICE,

BATTLEFORD, SASKATCHEWAN, April 3, 1909.

The Commissioner of Dominion Lands.

Ottawa.

SIR.—I have the honour to submit the annual report of this office for the year ending March 31, 1909.

Conditions during the past year have on the whole been favourable: the crops were good throughout this district, excepting oats and potatoes, which were under the average.

The weather during the months of January and February last was very cold, but milder than usual during March, and there is every indication of a very favourable spring. The snowfall was normal.

The southern part of this district is now served by two lines of railway, as indicated in my last year's report. Several branch lines are projected, and it is given out that the Grand Trunk Pacific Railway will build this year from Biggar, on their main line to this point, making connection here with the Canadian Northern Railway system. The two lines referred to in the south have been operated since last fall and have been the means of preventing any further trouble caused by the scarcity of fuel in that region. Many new towns have sprung up along these lines, where settlers find a market for their produce within easy reach. Grain elevators are already dotting the prairie and several thousand bushels of grain were shipped to eastern markets during the past fall and winter.

The new regulations coming into force on the 1st September last permitting entries for pre-emptions and purchased homesteads were taken advantage of by a large number of settlers. For several days the services of the police were required to handle and control the huge crowd awaiting admission. The heavy work it occasioned was done without any addition to the staff. Many hours of overtime were put in, and this was done with such good will and so much interest brought to the proper performance of the extra work that special mention must be made of it.

Settlement is now reaching out in every direction, and the opening of a sub-agency in one of the new towns in the south would be a great convenience to settlers coming over the Canadian Pacific and Grand Trunk Pacific Railways. A proper idea may be formed as to how rapidly settlement has been increasing from the fact that three years ago only about fifteen post offices could be found in this district, while at the present moment over one hundred and forty are in operation.

Following is a statement of the work performed during the year :—

|   |       |
|---|-------|
| Free homestead entries.....                       | 3,371 |
| Purchased homesteads.....                         | 138   |
| Pre-emptions.....                                 | 863   |
| Entries cancelled.....                            | 1,755 |
| Land scrip located (acres).....                   | 3,840 |
| Volunteer bounty land grants located (acres)..... | 4,478 |
| Timber permits issued.....                        | 356   |
| Hay permits issued.....                           | 209   |
| Grazing leases.....                               | 31    |

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|   |             |
|---|-------------|
| Applications for patent recommended.. . . . . | 1,506       |
| Letters received.... . . . .                  | 34,641      |
| Letters written.... . . . .                   | 31,199      |
| Total revenue.. . . . .                       | \$82,351 62 |

I have the honour to be, Sir,

Your obedient servant,

L. P. O. NOEL,

*Agent of Dominion Lands.*

**No. 5.**

REPORT OF THE AGENT AT BRANDON.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS OFFICE,

BRANDON, MANITOBA, April 1, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—In submitting the annual report for the year ending March 31 last, I beg to say there has been an increase in the several branches of work in this office, owing chiefly to the opening for homesteading of the odd numbered sections not appropriated by the Canadian Pacific Railway Company and a portion of the Spruce Wood reservation, which is shown by the summary of work performed.

The lands thus opened have been secured chiefly by settlers in the vicinity, all being anxious to increase their holdings. These lands are mainly suitable for pasturage and as the farmers have learned the advantages of mixed farming they were secured at once.

The cancellations have increased slightly, land being scarce in this agency. Those wishing to farm keep themselves advised of the standing of the homesteaders, and, where an entry is found in default, promptly apply for an inspection.

The prospects for the coming crop are excellent. There is more than the usual amount of moisture in the ground, owing to the many snowstorms which continued into the spring and not having the high drying winds. The farmers are all busy getting ready to get the crop in and a larger area is being sown yearly. The price of land is steadily increasing and the demand is fair; many farms have already changed hands at a high figure.

Immigration has commenced and from all parts people are pouring into the country; many going further west seeking homesteads, others remaining in the towns, procuring work at their various trades, work of all kinds being plentiful. The people each year are of a better class, many coming from England and the United States and bringing capital enough to settle themselves on their homesteads, others buying improved farms outside the towns.

The following is a statement of the work performed for the past twelve months, ending 31st ultimo :—

|                                       |       |
|---------------------------------------|-------|
| Homestead entries granted.... . . . . | 170   |
| Timber permits.. . . . .              | 370   |
| Entries cancelled.. . . . .           | 53    |
| Applications for patent.... . . . .   | 324   |
| Letters received.... . . . .          | 9,304 |
| Letters written.. . . . .             | 8,113 |

I am, Sir,

Your obedient servant,

L. J. CLEMENT,

*Agent of Dominion Lands.*

9-10 EDWARD VII., A. 1910

## No. 6.

## REPORT OF THE AGENT AT CALGARY.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

CALGARY, ALBERTA, May 12, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit my report of the work performed in this office during the twelve months ended March 31, 1909.

The number of homestead entries, 2,710, is an increase over the previous year of 1,430; in addition to which there were 115 purchased homesteads and 1,825 pre-emptions granted.

The revenue from lands amounts to \$100,163.42, exclusive of the amount paid at head office on account of sales of lands, grazing leases, &c., being an increase of \$62,953.20 over the revenue of the previous year.

As the business for the timber and mines and school lands branches for this district is also conducted at this office, I may mention that the revenue from these sources amounted to \$32,661.64, being a decrease of \$2,738.57 from the previous twelve months.

The prospects for a good crop this year are excellent, although it has been reported that the fall wheat has been damaged to a certain extent in some localities, but just how far this will prove true remains to be seen, as sometimes it is impossible to say at this particular season whether fall wheat has been damaged to any extent or not.

The winter was not a severe one, so far as bad storms were concerned; the thermometer registered around forty below zero for a short time, but little or no damage was done to stock on the ranges.

The price of beef has been considerably higher this spring than last.

Horses of all kinds never commanded a better price, heavy work horses being greatly in demand.

The settlers throughout this part of the country appear to be very contented, and hopeful, and with another crop this year, such as the one we had last the price of land will likely reach a higher figure, and there will be a greater rush for southern Alberta than ever before, although at the present time a great many people are coming into the country. For instance, entries covering about 1,250 quarter-sections were granted during the month of April this year, being an increase over the entries granted during the corresponding month of the previous year of about one thousand.

The city of Calgary continues to forge ahead very rapidly, the population now being in the neighbourhood of twenty-eight thousand, and the prospects for a very busy season never were better.

The detailed statement of receipts on account of Dominion lands was forwarded to head office on April 1, the day after the fiscal year expired.

I have the honour to be, Sir,

Your obedient servant,

J. R. SUTHERLAND,

*Agent of Dominion Lands.*

## No. 7.

## REPORT OF THE AGENT AT DAUPHIN.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

DAUPHIN, MANITOBA, March 31, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit my report on the business of the Dauphin Lands Office and District, for the year ending this day.

The year has shown a very marked increase in the number of homestead entries, over any former year during my tenure of office here, this being due principally to the opening of all hitherto undisposed of odd numbered sections on September 1 last. This caused a strenuous rush on the office for some time, and during the first few days it was found necessary to call in the assistance of the homestead inspectors, with some of the forest rangers, to control the great crowd, and keep order. The staff was equal to the occasion and handled the rush of work with despatch, though handicapped on account of the confined office space, and the fact that at the time alterations were being made in the building. A very large number of entries were passed, with little or no friction and but very few applicants went away dissatisfied, these few on account of not being able to secure such lands as they sought for. On the first day the crowd was so great that the stairs leading to the office broke down under the press. Fortunately, only one man was at all hurt, he only slightly, and he being admitted to the office through my private door, with the consent of those waiting in line, secured his entry.

The general work of the office has increased very rapidly, correspondence especially, this largely on account of the timber business, and owing to the fact that so many requisitions for timber permits are prepared by justices of the peace and commissioners who are not qualified to attempt such work, and who prepare the papers in an improper manner, and do not evidently question the applicants as to what timber they may already have had, what timber is on their own lands, or whether they have old permits still unreturned. It has been reported to me that in at least one case, these oversights are not unintentional, as a fee is charged each applicant for each and several affidavits taken by these officers. If it were possible, I would suggest, especially now that the quantities of available timber are becoming restricted, that all such requisitions might be taken only by some duly qualified officer of the department.

Some very heavy cuts of timber have been reported during the past winter, from the larger mill operators, and I expect that when the portable mill books are returned, it will be found that they also have taken out large quantities, the winter having been most favourable for this class of work, and with the exception of a very cold period during December, we had no severe weather. There was sufficient snow to facilitate work, though not too much, and judging from the number of permits issued, all classes of people took full advantage of the favourable conditions.

I would strongly recommend more careful supervision of the working of the portable mills, the owners of which, having no vested interests look only at the immediate profits to be derived, and slash timber without any attempt to economize. This work should, I believe, be kept strictly under the supervision of competent officers of the department, who should be detailed to watch the operations of as many mills as they could safely give attention to, and the tract where cutting is to be done, especially in the reserves, should be distinctly specified, only mature trees taken, and all tops, debris, &c., either piled or taken out of the bush to prevent fires running.

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I consider that it is quite impossible for the staff of rangers at present engaged, to keep sufficient watch on these numerous mills, and visit them as often as required in order to check their illegal cutting.

The cordwood business has been prosecuted to a considerable extent, and the Winnipeg market, as that of other larger places, looks for the northern tamarack, paying higher prices than for the product of other parts. Many cases of illegal cutting have been found and the trespassers made to pay the double dues, but in my opinion this penalty, 50 cents per cord, is not sufficient to deter some of the more irresponsible dealers who, if they can manage to get a few cars without dues, can well afford to pay when caught. I would advocate the confiscation of wood where found in possession of any dealer who had at any time previously been found with wood cut illegally and the sale of the wood irrespective of his claims. I think a very few examples along these lines would have a most deterring effect. A frequent, if not constant patrol of the lines of rail, where traversing timbered land should be carried out, as I find that immediately one of our officers leaves a certain section, the parties engaged at once repeat their offences, in the hope that they may dispose of their wood before the next visit.

The penalty of double dues on lumber is in my opinion no deterrent whatever, as parties wanting lumber can well afford to pay this, and still secure cheaper material than they can obtain through the legitimate dealers; and I find the same parties figuring in seizures time after time, this more especially from lands in the reserves.

Locally the crops were not up to the average, but to compensate for this, many sections of the district were especially well favoured, so that on the whole I am pleased to be able to report a favourable year for the entire district. Prices were high, and all grains for sale were marketed in good condition, so that perhaps quite as much was realized from the crops as in former years.

The last two seasons, when crops had been somewhat below the average, have caused the farmers to pay more attention to mixed farming and stock-raising, which will no doubt result in their advantage in the near future. There is still ample scope for further advancement along these lines, and the establishment of several creameries throughout the district will furnish a ready market for dairy products.

More attention could well be paid to hogs and poultry, as the supply has never as yet met the local demand, and during winter it is almost impossible to purchase fresh eggs, which command fancy prices. This could be remedied with but little trouble, and would yield the poultry man a splendid return on his outlay.

A number of pure bred animals for stud purposes have been imported, the result being easily seen in the improved herds found through the country, and this good line of work is still going on.

The usual amount of improvement in municipal matters is noticed, roads, bridges and ditches being built wherever called for, and though taxes are somewhat high in certain municipalities, the people feel the money is well spent, and the improvements are of a permanent character.

Schools and churches are springing up in all settlements when required, and general business, though perhaps not quite as brisk as in former years, has still been of a very satisfactory nature, but few failures being reported.

I feel that I cannot omit mentioning our various hospitals, which have, as usual, done noble work. Though no epidemics have visited us, still these institutions have been very busy, large numbers of accident cases coming to them from the numerous lumber camps as well as from the railways.

I attach a memo. of the principal lines of business carried through the office.

Your obedient servant,

F. K. HERCHMER,

*Agent of Dominion Lands.*

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|   | No.    |              |
|---|--------|--------------|
| Homestead entries granted.. . . . .     | 1,729  | \$ 17,120 90 |
| Interchanges.... . . . .                | 2      | 15 00        |
| Improvements collected.. . . . .        | 79     | 1,923 50     |
| Land sales (cash).... . . . .           | 32     | 4,164 03     |
| Land sales (scrip).. . . . .            | 1      | 80 00        |
| Sundries, searches, &c.... . . . .      | 383    | 193 45       |
| Total from lands.. . . . .              |        | \$ 23,414 98 |
| Timber permits issued.... . . . .       | 1,432  | 6,616 21     |
| Timber seizures.. . . . .               | 93     | 2,923 73     |
| Hay permits.... . . . .                 | 90     | 461 25       |
| Grazing leases.. . . . .                | 1      | 186 52       |
| Mining locations.... . . . .            | 1      | 5 00         |
| Total from timber and mines.. . . . .   |        | \$ 10,197 71 |
| School land sales (cash).... . . . .    | 2      | 505 22       |
| Seed grain collections.... . . . .      | 10     | 156 10       |
| Total miscellaneous.... . . . .         |        | 661 32       |
| Grand total revenue.. . . . .           |        | \$ 34,301 01 |
| Letters received.... . . . .            | 21,447 |              |
| Letters written.... . . . .             | 12,056 |              |
| Applications for patent taken.. . . . . | 386    |              |
| Entries cancelled.. . . . .             | 329    |              |

## No. 8.

## REPORT OF THE AGENT AT EDMONTON.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

EDMONTON, ALBERTA, April 17, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit the annual report of this office for the year ending March 31, 1909.

The financial year just closed opened under the somewhat unfavourable conditions brought about by the financial stringency which set in during the year 1907, and the partial failure of the crops during that season. The financial stringency continues, though somewhat modified, and another crop has been harvested which has netted the farmer a satisfactory return. Some damage was done to the crops by frost, wheat having suffered more particularly, but any loss sustained in this way was at least partially offset by the unusually high price paid for the products of the farm. The winter was an average one, with abundance of snow, and though the temperature registered unusually low, was free from severe storms. It would be quite safe to state that the condition of the settlers is fairly satisfactory.

There is a slight increase in the revenue of this office over that of last year, being \$87,532.46 as against \$76,473.35 for the preceding year. The portion of this accruing from the disposal of Dominion lands is \$62,011.55 as against \$48,400.18 for the preceding year, and the fact that homestead entry fees amounted to \$49,167, or about 80 per cent of the whole, shows that there is little activity along other lines, which was doubtless due to the scarcity of money.

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While it is noted with satisfaction that there has been an increase of about 30 per cent in the number of entries, it is only fair to state that the showing of this agency in this respect has suffered from the fact that almost none of the pre-emption area lay within its boundaries. The throwing open of odd numbered sections for settlement gave very general satisfaction, and created for a time a very marked activity in homesteading. These, together with some sixty townships that have been thrown open for settlement during the past year, would appear to have been sufficient to meet all reasonable demands.

Compared with the preceding year, the increase in the volume of correspondence is very marked, and the fact that a large percentage of it deals with inquiries of various kinds, is in itself a promise, if not an assurance, of great activity in the settlement of this district during the next fiscal year. The area of open prairie land now available within the district has become comparatively small, and one result is that many are directing their attention toward the Peace River district where it is understood there are larger stretches of open land. Judging from the correspondence, the increased attention being given by the department to this remoter Northwest will be much appreciated.

The following comparative figures will serve to indicate the progress of the district :—

| 1906-1907 (nine months). |            | 1907-1908 |             | 1908-1909. |             |
|--------------------------|------------|-----------|-------------|------------|-------------|
| Entries.                 | Revenue.   | Entries.  | Revenue.    | Entries.   | Revenue.    |
| 2,766                    | \$2,325 72 | 4,051     | \$76,473 35 | 5,242      | \$87,532 46 |

## SUMMARY OF WORK, 1908-1909.

|   |             |
|---|-------------|
| Letters received.....                     | 56,007      |
| Letters sent out.....                     | 46,229      |
| Applications for patent.....              | 2,070       |
| Homestead entries cancelled.....          | 2,137       |
| Hay permits issued.....                   | 262         |
| Timber permits issued.....                | 1,853       |
| Homestead entries granted.....            | 5,242       |
| South African veteran scrips located..... | 29          |
| Half-breed scrips located.....            | 25          |
| Revenue.....                              | \$87,532 46 |

Your obedient servant,

K. W. MACKENZIE,

*Agent of Dominion Lands.*

## No. 9.

## REPORT OF THE AGENT AT ESTEVAN.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS OFFICE.

ESTEVAN, SASKATCHEWAN, April 15, 1909.

The Commissioner of Dominion Lands,

Ottawa.

SIR.—I have the honour to submit the annual report of this office for the year ending March 31, 1909.

The past year has, on the whole, been very favourable; the yield of wheat, while not so heavy as in some previous years, was satisfactory and the high prices obtained made the crop a profitable one. The past winter has been unusually mild, and stock have come through in excellent condition. Seeding is general at this date, and it is



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expected that the area brought under cultivation will be about 25 per cent greater than last year. On the 1st September last the odd numbered sections in thirty-one townships in this district were thrown open to the settlers under the new Dominion Lands Act. On the opening of the office on that day a crowd of between 400 and 500 people were in line outside the building and were admitted by ticket; a large number of these people were homesteaders within the pre-emption area and were anxious to secure an adjoining quarter-section for a pre-emption. Land available for pre-emption entry, and contiguous to lands entered for as homesteads, were reserved for fifteen days so that the actual settlers had ample time to secure a pre-emption. The rush of applicants kept up until after the 19th, and during this time the staff worked cheerfully till a late hour each night.

Appended is a statement of work performed during the fiscal year.

|  |             |
|--|-------------|
| Letters received.....                          | 13,887      |
| Letters written.....                           | 12,125      |
| Applications for patent.....                   | 1,028       |
| Entries cancelled.....                         | 342         |
| Homestead entries.....                         | 840         |
| Pre-emption entries.....                       | 911         |
| Purchased homestead entries.....               | 57          |
| Land sales.....                                | 89          |
| Payments for improvements (2,282.90).....      | 45          |
| Payments on account of sundries (\$96.95)..... | 265         |
| Timber permits.....                            | 324         |
| Grazing rentals.....                           | 34          |
| Hay permits.....                               | 283         |
| Mining fees and rentals.....                   | 7           |
| Coal lands (application fees).....             | 18          |
| Coal lands (sales).....                        | 3           |
| Coal lands (royalty).....                      | 11          |
| Total revenue collected.....                   | \$35,147 85 |

I have the honour to be, Sir,

Your obedient servant,

R. CLAUD KISBEY,

*Agent of Dominion Lands.*

### No. 10.

#### REPORT OF THE AGENT AT HUMBOLDT.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS OFFICE.

HUMBOLDT, SASKATCHEWAN, April 6, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit the annual report of this office for the year ending March 31, 1909.

I regret to say that to the farmer the past year was an unfavourable one, the crops being much below the average. This has necessitated a large number of them raising loans on their farms, where they have procured their patents, at rates of interest none less than 8 per cent and as high as 10 and 12 per cent.

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As the farmers' success or otherwise in this country reflects on the whole commercial and industrial situation it would be well if some means could be devised whereby the man developing the resources of the country could procure the funds required for his work at more reasonable rates of interest and the question of the means to this end is one that might well engage the attention of the federal and provincial governments.

Notwithstanding the fact that a lean year has just passed, farmers and merchants, and in fact all business men appear to be singularly optimistic. Confidence is being restored in all lines of business from the financial institutions down, and this generally optimistic spirit is bound to have a great effect in again bringing about those conditions of prosperity that existed up to 1907. The reaction after the period of financial depression has, up to the present time been very gradual, but I look from now on for a greatly accelerated movement in the direction of better times.

The outstanding feature of the year's work was the bringing into force of the Dominion Lands Act of 1908. The opening of the undisposed of odd numbered sections to homestead entry made in this district about double the quantity of land available for entry at the time the Act became operative. The effects in this particular will be far-reaching in the solidifying of settlements, the easing of the burdens of taxation and the greater opportunity through increased settlement for educational development.

The pre-emption and purchased homestead provisions of the Act apply to only one range in this agency, and while it affects only that small portion of the district sixty-one pre-emptions and sixteen purchased homestead entries have been granted.

The purchased homestead privilege has permitted a number of very desirable settlers to acquire land at a very reasonable figure, and has been an undoubted boon to many settlers who have been able to take advantage of its provisions.

Appended is a statement of the transactions of this office for the year just ended.

Your obedient servant,

A. NORQUAY,

*Agent of Dominion Lands.*

|                                      |        |              |
|--------------------------------------|--------|--------------|
| Homestead entries.....               | 2,421  |              |
| Pre-emption entries.....             | 61     |              |
| Land sales.....                      | 27     |              |
| South African Veteran scrip.....     | 51     |              |
| Half-breeds scrip.....               | 1      |              |
| Purchased homesteads.....            | 16     |              |
| Patent Branch revenue.....           |        | \$ 33,858 00 |
|                                      |        | <hr/>        |
|                                      |        | \$ 33,858 00 |
| Timber permits.....                  | 418    |              |
| Hay permits.....                     | 60     |              |
| Timber and Mines Branch revenue..... |        | 293 20       |
| School lands sundries.....           | 150    |              |
| Provision collections.....           | 1      |              |
| Seed grain collections.....          | 3      |              |
| Miscellaneous revenue.....           |        | 901 69       |
|                                      |        | <hr/>        |
| Total.....                           |        | \$ 35,053 89 |
| Letters received.....                | 30,880 |              |
| Letters sent.....                    | 31,081 |              |
| Applications for patent.....         | 2,618  |              |
| Entries cancelled.....               | 1,126  |              |

## No. 11.

## REPORT OF THE AGENT AT KAMLOOPS.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

KAMLOOPS, B.C., April 7, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit my annual report for this office for the year ending March 31, 1909.

The harvest of 1908 was above the average, and the weather being favourable, was well harvested.

The market for grain, roots, hay and stock was good and prices high. Stock of all kinds went into winter quarters in good condition, and the winter season being favourable have come through in good shape without loss, and stockmen report a surplus of hay on hand.

The work of the office shows a decided increase, with the exception of land sales. This is accounted for by all the land in the railway belt being withdrawn from sale. Homestead entries have more than doubled any previous year. The department is contemplating sales in the dry belt under strict conditions as to irrigation; this, in my opinion, is the only manner in which the dry belt can be made productive.

The laws governing the disposal and distribution of water for irrigation were repealed at the last session of the provincial legislature, and many hope that some of the disabilities under which they have suffered in the past have been removed, but as the Act is not yet in force it remains to be seen how beneficial the new Act will prove.

Some small areas which have been logged over have been withdrawn from timber berths and the lands dealt with according to the regulations. I understand that an inspector of timber berths has been appointed by the department with a view to having the lands which have been denuded of timber, and which are suitable for agriculture, withdrawn from the berths and made available for settlement. This action is highly commendable, and if thoroughly carried out will be the means of clearing up a large number of applications in this office.

The district is particularly prosperous, spring has opened up favourably, and with the anticipation of the resumption of mining there is every evidence of continued prosperity.

The following is a summary of the work performed in this office during the fiscal year :—

|                                  |              |
|----------------------------------|--------------|
| Letters received.....            | 4,400        |
| Letters written.....             | 4,400        |
| Homestead entries granted.....   | 400          |
| Homestead entries cancelled..... | 70           |
| General sales.....               | 50           |
| Townsite sales.....              | 5            |
| Hay permits.....                 | 9            |
| Applications for patent.....     | 83           |
| Grazing rents.....               | 302          |
| Registrations.....               | 17           |
| Total revenue collected.....     | \$ 19,766 27 |

Your obedient servant,

A. B. CURRIE,

*Agent of Dominion Lands.*

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No. 12.

REPORT OF THE AGENT AT LETHBRIDGE.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

LETHBRIDGE, ALBERTA, April 13, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit for your consideration this office's annual report for the year ending March 31, 1909.

I have much pleasure in stating that the rush of settlers to this district still continues and the numbers far exceed those of any previous year. These settlers come from all parts of the world, but more particularly might I mention those coming from the United States as well as eastern Canada.

Settlement is reaching out in every direction and in order to provide suitable locations for incoming settlers it will be necessary to have surveys in this district proceeded with immediately.

The homestead entries for the Lethbridge agency far outnumber those of any previous year. The work of the office has almost doubled in every branch but has been disposed of satisfactorily.

The sub-agents and homestead inspectors have been very busy and deserve credit for the manner in which they have performed their departmental duties. The staff has worked faithfully and is deserving of special mention.

The following is a partial list of the work performed during the past year :—

|                                       |        |
|---------------------------------------|--------|
| Letters received.....                 | 31,574 |
| Letters written.....                  | 24,962 |
| Applications for patent received..... | 1,201  |
| Homestead entries granted.....        | 3,820  |
| Pre-emption entries granted.....      | 2,656  |
| Purchased homesteads granted.....     | 71     |
| General sales.....                    | 209    |
| Entries cancelled.....                | 1,290  |
| Hay permits issued.....               | 124    |
| Timber permits.....                   | 402    |
| Timber seizures.....                  | 6      |
| Grazing rents.....                    | 249    |

The total revenue collected for the fiscal year of 1908-9 is \$148,560.52.

Your obedient servant,

J. W. STAFFORD,

*Agent of Dominion Lands.*

No. 13.

REPORT OF THE AGENT AT MOOSEJAW.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

MOOSEJAW, SASKATCHEWAN, May 4, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit the annual report of this office for the fiscal year ending March 31, 1909.

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It is with much satisfaction that I am able to allude to the foregoing year as the most successful ever experienced in the settlement of the west from the viewpoint of the number of homestead entries granted, and in this respect the Moosejaw district has been favoured as the centre of unusual attraction to land-seekers.

The greatest stampede for land commenced on September 1 last when the new Dominion Lands Bill came into force, and since that time the opening from time to time of a large number of newly surveyed townships has resulted in some particularly noted rushes for land.

There is still a large unsettled area of good land in different parts of this district, and although these parts, in some cases, are a considerable distance from existing railroads, settlement is going on at a rapid rate.

From present indications the current year will be a most prosperous one. Seeding operations are well advanced at this point and conditions generally are very promising.

Appended is a statement of work performed during the fiscal year.

Your obedient servant,

J. RUTHERFORD,

*Agent of Dominion Lands.*

| Patent Branch—                        | Number. | Revenue.                       |
|---------------------------------------|---------|--------------------------------|
| Homestead entries.....                | 8,720   | \$ 86,970 00                   |
| Pre-emption entries.....              | 7,229   | 71,680 00                      |
| Purchased homestead entries.....      | 249     | 2,480 00                       |
| Improvements.....                     | 194     | 9,181 35                       |
| Land sales (cash).....                | 293     | 50,901 45                      |
| Land sales (scrip).....               | 45      | 6,794 25                       |
| Land scrip (32,942 acres).....        | 110     |                                |
| Sundries.....                         | 443     | 272 70                         |
|                                       |         | <hr/> \$228,279 75 <hr/>       |
| <br>Timber and Mines Branch—          |         |                                |
| Royalty on sales.....                 | 1       | \$ 4 00                        |
| Timber permits.....                   | 756     | 205 47                         |
| Hay permits.....                      | 429     | 1,322 25                       |
| Grazing rents.....                    | 69      | 2,363 19                       |
| Mining fees.....                      | 2       | 10 60                          |
| Coal lands fees, &c.....              | 4       | 14 56                          |
| Sundries.....                         | 2       | 3 50                           |
|                                       |         | <hr/> \$ 3,922 97 <hr/>        |
| <br>Miscellaneous—                    |         |                                |
| School lands sundries.....            | 141     | \$ 912 79                      |
| Seed grain collections.....           | 13      | 620 16                         |
|                                       |         | <hr/> \$ 1,532 95 <hr/>        |
| Total revenue.....                    |         | <hr/> <hr/> \$233,735 67 <hr/> |
| Letters received.....                 | 60,766  |                                |
| Letters written.....                  | 77,000  |                                |
| Applications for patent received..... | 1,988   |                                |
| Entries cancelled.....                | 2,988   |                                |

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## No. 14.

## REPORT OF THE AGENT AT NEW WESTMINSTER.

DEPARTMENT OF THE INTERIOR.

DOMINION LANDS OFFICE,

NEW WESTMINSTER, B.C., April 6, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR.—In accordance with the departmental instructions I have the honour to submit my report for the fiscal year ended March 31, 1909.

There has been a constantly increasing number of people coming to the Pacific coast from the eastern provinces, but the great majority of those who desire lands for homes are purchasing small parcels from the subdivided areas in the New Westminster district, because the remaining Dominion lands are usually in isolated places without roads.

As was the case last year, nearly all to whom formal homestead entries were granted have been residing on their locations many months before surveys reached them. The time of residence is counted when they make their applications for patent, and thus I find that these people exercise great diligence to make a good showing in their period of residence. I may also state that a large number of people pass through this district over the Canadian Pacific Railway on their way from the Pacific states of Washington, Oregon and California to Alberta and Saskatchewan. Many of these arrive in Vancouver city without settler's certificates, and when they come to Canadian Pacific offices for the reduced rate it is necessary that they come to me at New Westminster for the requisite completion of forms of declaration, &c., under which letters of recommendation are issued by me.

This service has gone on for years, but this year has surpassed others in the number of such applications.

Much of my time is consumed in immediate attention to these cases, because delay would mean more expense to them.

I have been hoping for years that the pressure on my time might be relaxing with the settlement of the great bulk of the land matters of the district, but I find that with the increase of population round about there are constantly arising new and perplexing questions and greater intensity in obtaining ready solutions.

Great relief has come to many people by circumstances which caused the removal of mortgages that weighed down the best energies. It is to be hoped that these deadly incumbrances on small and unproductive bush places will pass away in the main.

With the constantly rapid growth of the city of Vancouver and the stimulus given to this city of New Westminster, and the many smaller towns and villages along the lower Fraser valley, it is not too much to hope that nearly all the agricultural lands, or such as are capable of being tilled in the valley will be developed to supply the markets. At the present time there is much encouragement along these lines as the prices of all productions are acknowledged to be very satisfactory.

I extract the following from the monthly summaries furnished the inspector of agencies and the head office:—

|   |            |
|---|------------|
| Letters received (increase of over 400) . . . . .               | 2,923      |
| Letters sent (increase of nearly 500) . . . . .                 | 2,614      |
| Applications for patent recommended . . . . .                   | 30         |
| Homestead entries . . . . .                                     | 32         |
| Total receipts (besides some payments at head office) . . . . . | \$2,863 85 |

The receipts include nine payments of \$5 each on applications for coal mining leases.

Your obedient servant,

JOHN MCKENZIE,

*Agent of Dominion Lands.*

## No. 15.

## REPORT OF THE AGENT AT PRINCE ALBERT.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS OFFICE,

PRINCE ALBERT, SASKATCHEWAN, April 10, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit for your consideration the annual report of this office for the fiscal year ending March 31, 1909.

The attached statement, marked Schedule 'A,' gives a summary of the work performed and of the revenue collected during the year, also that for the previous year, and shows in detail the increase or decrease as compared with the year ending March 31, 1908.

From this schedule you will see that the revenue collected for the year just closed is \$75,651.57 as compared with \$53,663.22 for the previous year, being an increase of \$21,988.35.

The number of homestead entries granted during the year was 2,079. There were also 57 pre-emption entries and 52 purchased homesteads, making a total of 2,180, being an increase of 562 over the previous year.

There is a large area of surveyed land still available for settlement in this district, the majority of which is excellently adapted for mixed farming, there being abundance of good water and excellent timber for shelter and fuel, and as the past two seasons have shown the profit to be derived from, and the safety of the investment in this class of farming I anticipate an even greater influx of settlers during the present year than was experienced during that just closed.

Attached hereto is a statement marked Schedule 'B,' showing the revenue collected in connection with the School Lands Branch, from which you will see that the revenue from this source has also increased.

The work and revenue connected with the Timber Branch show a decided increase over the previous year as does also that of the Mines Branch; these will, however, be dealt with under separate reports.

In conclusion I would say that notwithstanding the large and general increase both of work and revenue experienced in this district during the year just closed I anticipate an even greater increase during the present year, this anticipation not being mere conjecture, but borne out by the large number of letters of inquiry received from intending settlers and investors, not only from different parts of Canada and the United States, but from Great Britain and many of her colonies, from continental Europe, Africa and South America, which would appear to show that the large district north of Prince Albert is practically just commencing to be opened up and the immense and varied resources just beginning to be developed.

Your obedient servant,

GEO. L. DEMPSTER,  
*Agent of Dominion Lands.*

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## SCHEDULE A.

STATEMENT of the business transacted at the Prince Albert Dominion Lands and Timber Agency for the Year ending March 31, 1909, and comparative statements showing previous year's business and increase or decrease therefrom.

|                                 | WORK AND RECEIPTS FOR YEAR ENDING MARCH 31, 1909. |                    | CORRESPONDING PERIOD FOR PREVIOUS YEAR. |       | INCREASE OVER PREVIOUS YEAR. |                    | DECREASE FROM PREVIOUS YEAR. |                    |
|---------------------------------|---|--------------------|---|-------|------------------------------|--------------------|------------------------------|--------------------|
|                                 | No.   | Amount.<br>\$ cts. | Totals.<br>\$ cts.                      | No.   | Amount.<br>\$ cts.           | Totals.<br>\$ cts. | No.                          | Amount.<br>\$ cts. |
| <i>Patent Branch.</i>           |   |                    |   |       |                              |                    |                              |                    |
| Homesteads.....                 | 2,079   | 20,165 00          |   | 1,626 | 16,000 00                    |                    | 453                          | 4,165 00           |
| Pre-empions.....                | 57  | 570 00             |   | Nil.  |                              |                    | 57                           | 570 00             |
| Purchased homesteads.....       | 52  | 7,358 50           |   | "     |                              |                    | 52                           | 7,358 50           |
| Improvements.....               | 87  | 2,841 17           |   | 178   | 5,120 87                     |                    | 91                           | 2,279 70           |
| Land sales—Cash.....            | 26  | 3,409 73           |   | 29    | 2,066 53                     |                    | 3                            | 1,343 20           |
| " Scrip.....                    | 6   | 880 00             |   | 4     | 1,039 58                     |                    | 2                            |                    |
| Town site sales.....            | Nil.  |                    |   | Nil.  |                              |                    | 180                          | 47 66              |
| Sundries.....                   | 230   | 62 01              |   | 50    | 11 35                        |                    |                              |                    |
| Dominion Lands, total.....      |   |                    | 35,286 50                               |       |                              | 24,241 33          |                              | 11,045 17          |
| <i>Timber and Mines Branch.</i> |   |                    |   |       |                              |                    |                              |                    |
| Bonns.....                      | Nil.  |                    |   | Nil.  |                              |                    |                              |                    |
| Ground rent.....                | 38  | 4,793 05           |   | 28    | 5,928 50                     |                    | 10                           | 1,135 45           |
| Royalty on sales.....           | 38  | 27,456 22          |   | 32    | 16,251 93                    |                    | 6                            | 11,204 29          |
| Timber permits.....             | 1,357   | 3,931 20           |   | 1,974 | 5,491 55                     |                    | 283                          | 1,563 35           |
| Timber seizures.....            | 56  | 1,621 06           |   | 33    | 445 81                       |                    | 23                           | 1,175 25           |
| Hay permits.....                | 176   | 428 25             |   | 70    | 209 75                       |                    | 106                          | 218 50             |
| Grazing rents.....              | Nil.  |                    |   | 1     | 3 20                         |                    | 1                            | 3 20               |
| Mining fees.....                | 115   | 847 50             |   | 3     | 15 00                        |                    | 112                          | 832 50             |
| Coal lands fees, &c.....        | Nil.  |                    |   | 3     | 15 00                        |                    | 3                            | 15 00              |
| Stone quarries.....             | "   |                    |   | Nil.  |                              |                    |                              |                    |
| Sundries.....                   | "   |                    |   | "     |                              |                    |                              |                    |
| Timber dues, &c., total.....    |   |                    | 39,077 28                               |       |                              | 28,363 74          |                              | 10,713 54          |
| <i>Miscellaneous.</i>           |   |                    |   |       |                              |                    |                              |                    |
| School lands sales.....         | Nil.  |                    |   | Nil.  |                              |                    |                              |                    |
| " sundries.....                 |   | 857 85             |   |       | 679 02                       |                    |                              | 178 83             |



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|  | 429 04 | 1,287 79  | 379 13 | 1,058 15  | 50 81 | 229 04    |
|--|--------|-----------|--------|-----------|-------|-----------|
| Seed grain collections .....           |        |           |        |           |       |           |
| Miscellaneous, total .....             |        |           |        |           |       |           |
| Grand total, .....                     |        | 75,651 57 |        | 53,963 22 |       | 21,988 35 |
| Letters received .....                 | 15,442 |           | 13,379 |           | 2,063 |           |
| Letters written .....                  | 13,081 |           | 9,968  |           | 3,113 |           |
| Applications for patent received ..... | 863    |           | 848    |           | 15    |           |
| Entries cancelled .....                | 755    |           | 667    |           | 88    |           |

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## SCHEDULE B.

SCHEDULE showing Revenue from School Lands collected during the Fiscal Year ending March 31, 1909.

| Month.              | Grazing and Rental. | Hay Permits. | Timber Permits. | Cultivation Permits. | Grand total. |
|---------------------|---------------------|--------------|-----------------|----------------------|--------------|
|                     | \$ cts.             | \$ cts.      | \$ cts.         | \$ cts.              | \$ cts.      |
| April, 1908 .....   | 25 50               | 96 10        |                 |                      | 121 60       |
| May .....           | 38 64               | 29 50        |                 |                      | 68 14        |
| June .....          | 12 80               | 41 60        | 1 25            |                      | 55 65        |
| July .....          | 70 40               | 200 30       |                 |                      | 270 70       |
| August .....        | 44 80               | 25 20        |                 |                      | 70 00        |
| September .....     | 27 81               | 2 70         |                 |                      | 30 51        |
| October .....       | 32 00               |              | 7 75            |                      | 39 75        |
| November .....      | 32 00               |              | 6 25            |                      | 38 25        |
| December .....      | 38 40               | 20           | 1 50            |                      | 40 19        |
| January, 1909 ..... | 6 40                | 30           |                 |                      | 6 70         |
| February .....      | 25 60               | 1 00         |                 | 10 00                | 36 60        |
| March .....         | 57 60               |              | 22 25           |                      | 79 85        |
| Totals .....        | 411 95              | 396 90       | 39 00           | 10 00                | 857 85       |

## No. 16.

## REPORT OF THE AGENT AT RED DEER.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

RED DEER, ALBERTA, April 13, 1909.

J. W. GREENWAY, Esq.,

Commissioner of Dominion Lands,  
Ottawa.

SIR.—In submitting my annual report for the fiscal year ending March 31 it is gratifying to be able to advise you of the great progress made in the Red Deer district. A bountiful harvest, with good prices for all farm products, following the unfavourable summer of 1907, and the general depression owing to the financial stringency, put new life into the settlers. The foresight of the government in rendering assistance to the settlers by supplying them with seed grain came as a welcome relief to many, especially of the newer and poorer class, who, through the unfavourable season before mentioned, were not in a position to import seed grain, and had it not been for this wise action on the part of the government hundreds of acres of land which were broken and prepared for the seed would have been allowed to lie idle, thousands of bushels of grain, consequently a very large sum of money, would have been lost to the country, which would have received a set-back from which it would take a long time to recover. The seed furnished proved to be of excellent quality and great credit is due to all who took part in selecting the grain and in its distribution, which was carried out in a very satisfactory manner. The spring of 1908 was a most propitious one for seeding operations, and was followed by a fine summer, and delightful harvest weather; as a consequence excellent crops of all cereals were garnered, for which good prices were realized, and if the elements are as propitious the coming season, a year of increased prosperity is undoubtedly in store for this district and the province at large. This year will undoubtedly be one of great railway development, and the provincial government are to be commended for their railway policy. The branch line from Lacombe to Stettler will be extended to Castor, on Beaver Dam

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creek, a distance of some 45 miles, and will be completed in time to handle this year's crop. This extension will serve one of the most productive grain sections of this district, if not of the province, and will encourage the settlers in the eastern portion of the district to put larger areas of land in crop.

The telephone policy of the provincial government is being successfully and satisfactorily carried out, and over six hundred miles of rural telephone wires were stretched in 1908.

The past winter has been a very favourable one for cattle and no losses have been experienced on the ranges. The farmers and ranchers are turning their attention to the improvement of their breeding stock, and the days of the doggie and cayuse are past. In this connection I might mention an importation of pure bred stallions and mares recently made by Mr. G. F. Root, one of our progressive ranchers. This is the second importation made by this gentleman, and includes horses from the stables of such well known breeders of high grade stock as M. Medard, M. Tauchean and M. Lecourt, Department of Sarthe, France, and from Messrs. Watson, Woods Bros. and Kelly, of Lincoln, Nebraska, U.S.A. Messrs. Trimble and Richards, also successful ranchers, have imported some choice Ayrshire cattle selected from the best herds in Ontario and Quebec, and Mr. Sharman has imported a herd of thoroughbred Jerseys. When I mention that all these importers live in the immediate vicinity of Red Deer, you will have some idea of the importance of the cattle industry in this district. Whilst the horse and cattle industries have thus been well looked after, our fish and game have not been neglected. In October last the Dominion government made a shipment of young black bass to the west, of which Red Deer secured 1,000, which were successfully planted in Sylvan lake, a beautiful sheet of water, and famous summer resort, some twelve miles west of the town. Pine lake, Gull lake and other lakes were also stocked with these valuable fish, which I have no doubt will do well. The Alberta Fish and Game Association have done much for the protection and propagation of fish and game and have, at a large expense, imported a number of partridges and pheasants, which are doing well.

The creameries and cheese factories in the district have had a most successful year. Prairie and forest fires have been practically unknown during the past year.

The new Dominion Lands Act, better known as the 'Oliver Act,' is giving general satisfaction. There were comparatively few quarter sections available for pre-emption entry in this district, and most of them have been taken. A large number of South African bounty warrants have been located in this district. Appended is a statement of work for the fiscal year :—

|                              |        |              |
|------------------------------|--------|--------------|
| Homestead entries.....       | 20,080 | \$ 20,755 00 |
| Pre-emptions.....            | 128    | 1,280 00     |
| Purchased homesteads.....    | 22     | 220 00       |
| Inspections.....             | 837    |              |
| Cancellations.....           | 1,109  |              |
| Improvements.....            | 155    | 6,288 77     |
| Sales.....                   | 54     | 5,298 65     |
| Sundries.....                | 47     | 27 60        |
| Letters received.....        | 18,525 |              |
| Letters written.....         | 17,127 |              |
| Applications for patent..... | 1,042  |              |
|                              |        | <hr/>        |
|                              |        | \$ 33,870 02 |

There were 9,230 acres located under South African military bounty warrants and 1,202.9 acres under Northwest Half-breed scrip.

Your obedient servant,

W. H. COTTINGHAM,  
*Agent of Dominion Lands.*

No. 17.

REPORT OF THE AGENT AT REGINA.

DEPARTMENT OF THE INTERIOR.

DOMINION LANDS OFFICE.

REGINA, SASKATCHEWAN, April 2, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to submit my report for the fiscal year ending March 31, 1909.

On account of the bulk of the available homesteading lands in this district being disposed of, occasioned by settlement and opening of new land offices, the work in this particular has materially fallen off.

The opening of the odd numbered sections for homesteading and pre-emption entries was a source of satisfaction to settlers who availed themselves of the privilege of securing good lands, and the lands which became vacant in this district at that time were readily taken up.

The work in the other branches has not decreased to any great extent; especially does this refer to the patents and correspondence.

During the past year and more, especially the last few months, I have received a great number of letters from parties in the United States and other countries for information regarding this country as a place of settlement. These inquiries have received prompt attention, and letters as well as literature have been sent them, and the prospects look bright for a large immigration during the present year.

Spring appears to be opening up early and prospects look bright. Settlers and others seem to be recovering from the depression of the last two years and everything seems to point to a good season with prospects of a bountiful harvest.

Appended is a statement of work performed during the fiscal year.

Patents Branch—

|                            |       |              |
|----------------------------|-------|--------------|
| Homestead entries.....     | 1,556 | \$ 15,779 00 |
| Pre-emption entries.....   | 438   | 4,380 00     |
| Purchased home-steads..... | 107   | 17,575 00    |
| Improvements.....          | 138   | 7,593 38     |
| Land sales.....            | 90    | 16,832 89    |
| Sundries.....              |       | 246 49       |

Timber and Mines—

|                      |     |           |
|----------------------|-----|-----------|
| Timber permits.....  | 315 | \$ 170 25 |
| Timber seizures..... | 2   | 4 50      |
| Hay permits.....     | 254 | 697 50    |
| Grazing rents.....   | 63  | 781 71    |
| Sundries.....        | 3   | 28 15     |

Miscellaneous—

|                             |    |             |
|-----------------------------|----|-------------|
| School lands sales.....     | 8  | \$ 2,140 77 |
| Seed grain collections..... | 33 | 1,407 42    |

Grand Total.....\$67,637 96

|  |              |
|--|--------------|
| Land scrips located, 13 for.....                 | 2,508 acres. |
| Letters received.....                            | 37,489       |
| Letters written.....                             | 34,660       |
| Applications for patent sent to head office..... | 2,743        |
| Entries cancelled.....                           | 737          |

Your obedient servant,

L. RANKIN,

Agent of Dominion Lands.

No. 18.

REPORT OF THE AGENT AT WINNIPEG.

DEPARTMENT OF THE INTERIOR.

DOMINION LANDS OFFICE.

J. W. GREENWAY, Esq.,

WINNIPEG, MANITOBA, May 25, 1909.

Commissioner of Dominion Lands,  
Ottawa.

SIR.—I beg to submit my report upon the working of the Dominion Lands Office, at Winnipeg, for the departmental year ended March 31, 1909.

The volume of business in every branch of the work was considerably larger than that of any previous year in the history of the office. The homestead entries granted numbered 1,865, more than double those of the previous year; the revenue also shows a decided increase, the amount being \$127,949.83 as against \$98,375.70, for the year ended March 31, 1908, of which \$30,141.36 was collected from the following sources:—

|  |              |
|--|--------------|
| 1,865 homestead entry fees. . . . .                                | \$ 18,430 00 |
| 53 collections for improvements upon cancelled homesteads. . . . . | 1,458 42     |
| 58 land sales, cash account. . . . .                               | 4,671 86     |
| 14 land sales, scrip account. . . . .                              | 3,837 36     |
| 107 townsite lot sales account. . . . .                            | 1,286 30     |
| 1,649 township plans, searches, &c. . . . .                        | 457 42       |
|  | <hr/>        |
|  | \$ 30,141 36 |
| School lands. . . . .  | 6,218 56     |
| Timber and mines. . . . .  | 90,885 18    |
| Seed grain. . . . .  | 704 53       |
|  | <hr/>        |
|  | \$127,949 83 |
|  | <hr/> <hr/>  |

The collections on account of school lands represented payments received on 19 land sales, 420 hay permits and on 18 payments in settlement for advances for seed grain and provisions made to the settlers who suffered loss from the grasshopper plague in the seventies, and to Galicians more recently, from flooding of their lands.

The office correspondence was large; no less than 24,382 letters were written and 22,130 received. The number of homestead entries cancelled was 468, while 300 applications for patent were taken.

The year has been a most profitable one for the great majority of the farmers in this district. Crops of all kinds gave good returns, and prices for cereals, dairy and other farm products were high, for which there was an active market. Beef sold at a low price during the summer, but improved later and at present is high and nets the stockman a good margin of profit.

Settlers residing upon homesteads in the bush districts in the northern and eastern portions of this agency will be greatly benefited by the opening of the odd numbered sections for homesteading. The opening up and keeping of roads in repair bore very heavily upon the scattered settlers. It was found difficult to support and maintain churches, and frequently there was not a sufficient number of children in a township to secure a public school. Settlement will be made more compact by the opening of the odd numbered sections, and the difficulties pointed out will soon disappear.

I have much pleasure in stating that the members of the staff attached to the Lands Branch have shown great interest in their work and have rendered faithful service.

Your obedient servant,

E. F. STEPHENSON,

Agent of Dominion Lands.

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## No. 19.

## REPORT OF THE AGENT AT YORKTON.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS OFFICE,

YORKTON, SASKATCHEWAN, April 16, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I beg to submit for your consideration the report of the transactions of this office for the year ending 31st ultimo.

Homestead entries show a decrease, being 2,183 as against 2,840 of the former year. On September 1 last a number of odd sections were made available for entry, which occasioned some lively scenes again before the office building, but not of a prolonged duration, as by far the larger part of the odd sections in this agency had been appropriated by railway, colonization and land companies, and the applications for entry were taken without undue interference with the ordinary routine business.

Homesteaders who made entry on former Donkhor lands last year have generally strictly complied with the regulations, being warned that no leniency or laxity would be tolerated in these cases.

The wisdom of furnishing seed grain last year has been fully justified, as, although the season was rather unfavourable to the growth of oats, the staple crop of the district, the samples marketed were of the highest grade and change of seed proved beneficial. The distribution of seed grain and the gathering together of the surplus being entrusted to the homestead inspectors, deranged inspections and placed the work of these officials somewhat in arrears.

The building of the Grand Trunk Pacific Railway through the south part of the agency has brought many settlements within easy transportation distance for grain and other farm products. The extension of the Canadian Pacific northwestern branch, and the proposed building of the Canadian Northern Rossburn branch, together with lines already in existence, will accommodate every homesteader in the district with close market facilities.

The crop last year was a disappointment. Frost touched most of the wheat and dry weather adversely affected oats.

The following is a summary of the work transacted :—

|                              |             |
|------------------------------|-------------|
| Homestead entries.....       | 2,183       |
| Timber permits.....          | 568         |
| Hay permits.....             | 199         |
| Letters received.....        | 29,766      |
| Letters written.....         | 22,099      |
| Applications for patent..... | 1,462       |
| Entries cancelled.....       | 963         |
| Revenue.....                 | \$39,812 29 |

Your obedient servant,

JAS. E. PEAKER,

*Agent of Dominion Lands.*

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## No. 20.

## REPORT OF THE MINING LANDS AND YUKON BRANCH.

DEPARTMENT OF THE INTERIOR,

OTTAWA, May 22, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR.—I have the honour to submit herewith the report of the Mining Lands and Yukon Branch of the Department of the Interior for the fiscal year which ended on March 31, 1909.

Owing to the fact of there being a 'Mines Branch' in the Department of Mines it was thought advisable to change the name of this branch to 'The Mining Lands and Yukon Branch,' not only to avoid conflict in respect of the similarity of names, but also to more correctly give expression to the character and duties of this branch.

The total revenue of this branch derived from all sources during the fiscal year amounts to \$584,157.65, and the statements lettered 'A' and 'B,' showing in different forms how this amount is made up, will be found at the end of the report. Statement lettered 'A' shows the total revenue for each month, and statement lettered 'B' shows the revenue collected at each agency, including the Yukon Territory.

The revenue for the Yukon Territory, which amounts to \$230,171.89, is shown separately in statement lettered 'C.'

The reports and statements for the fiscal year from the gold commissioner, the comptroller, the Crown timber and land agent and the government mining engineer at Dawson, and the assistant gold commissioner at Whitehorse will be found under Part VI. of the general report.

## TIMBER IN THE YUKON TERRITORY.

The total amount of dues collected on account of timber in the Yukon Territory during the fiscal year was \$26,482.64.

There are in existence 114 timber berths held under license to cut timber within the territory, covering an area of 269.86 square miles, which licenses were granted prior to May 10, 1906, on which date the regulations governing the granting of licenses to cut timber in the Territory were rescinded, and regulations for the issue of permits to cut such timber substituted therefor. Two saw-mills are in operation within the Territory, one on the Klondike river, near Dawson, and one on Twelvemile river.

According to returns received in the department the number of feet, board measure, of lumber manufactured during the year was 2,129,413, and the quantity sold 2,358,973, a quantity of the lumber having been held over from the previous year. The number of cords of wood cut during the year was 10,545, and the number sold 8,493½. This does not include the very large amount of timber and cordwood cut free of dues for mining purposes.

## MINING LANDS OTHER THAN COAL.

During the fiscal year 217 entries for quartz mining claims were granted by the agents of Dominion lands in Manitoba, Saskatchewan and Alberta.

In the Yukon Territory 39,199 placer mining claims, 8,971 quartz mining claims and 64,223 renewals and relocations were recorded up to March 31, 1909.

According to the returns received during the fiscal year 909 entries for placer mining claims, 563 entries for quartz mining claims and 4,385 renewals and relocations were recorded during that period. The revenue collected from these sources and from fees for registering documents in connection with mining operations was \$88,828.50.

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## ROYALTY ON GOLD MINED IN THE YUKON TERRITORY.

The total amount collected up to March 31, 1909, for royalty on the gross output of placer mining claims in the Yukon Territory, after deducting the exemption at one time allowed under the regulations, is \$3,704,647.15, of which amount \$81,507.07 was collected during the last fiscal year. For the purpose of estimating this royalty, the gold is valued at \$15 an ounce, which is much below its real value.

The actual value of gold produced from placer mining operations in the Yukon Territory up to the 31st of March last might be safely placed at \$104,952,721.82.

The following statement shows the agencies at which the royalty was collected and the amount collected at each during the year :—

|                     |             |
|---------------------|-------------|
| Dawson. . . . .     | \$79,791 02 |
| Whitehorse. . . . . | 1,715 30    |
| Fortymile. . . . .  | 0 75        |

Sixty-nine leases to dredge for minerals, other than coal, in the submerged beds of rivers in the Yukon Territory are now in force, covering a total frontage of 399.26 miles. The total revenue derived from this source up to March 31, 1909, amounts to \$179,672.09, of which amount, \$10,272.07 was collected during the fiscal year. Twelve leases, including 96 miles of the beds of rivers, were issued during the fiscal year.

These leases are confined to the Yukon, Stewart, McQuestion, Fortymile, Big Salmon, Klondike and Hootalinqua rivers.

There are in operation in the Yukon Territory thirteen dredges, nearly all of which have an indicated capacity of 3,000 cubic yards in 24 hours. Several additional dredges have been ordered and will be in operation during the present season.

Forty leases to dredge for minerals in the beds of rivers in the provinces of Alberta and Saskatchewan are in force, covering a total frontage of 199 miles. Of these leases 26 are in the province of Alberta, and include 129 miles, and 14 are in the province of Saskatchewan, and include 70 miles in all. Three leases, including a total frontage of 11 miles of the western shore of Cedar lake, in the Northwest Territories to dredge for amber, are also in force. The total revenue derived from this source up to March 31, 1909, amounts to \$39,455.30, of which amount \$916.27 was collected during the fiscal year.

## PETROLEUM.

During the year 21 reservations have been made under the provisions of the regulations to enable the several applicants to conduct petroleum prospecting operations on the tracts reserved. These reservations embraced a total approximate area of 37,622.53 acres, and evidence has been filed in the department to show that at least 17 petroleum prospecting outfits have been installed, and that operations are being actively carried on. Representations have also been made in respect of two of these reservations on the Athabaska river, that oil in paying quantities has been discovered, which representations, however, have not yet been confirmed by an inspection.

## HYDRAULIC MINING.

The regulations for the disposal of mining locations in the Yukon Territory to be worked by the hydraulic mining process were withdrawn by order in council, dated February 2, 1904, such withdrawal, however, not to affect leases already granted. Twelve hydraulic mining leases are still in force, covering a total frontage of 38.48 miles. These leaseholds are all situated in the Yukon Territory. Since the regulations were first established in December, 1898, forty-seven hydraulic mining leases have been issued, all of which have now been cancelled with the exception of the above number. Under the grouping provisions of the Placer Mining Act, operators can now acquire and group for operation a sufficient area to warrant the installation of efficient hydraulic machinery.



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## WATER RIGHTS.

There are now in force in the Yukon Territory 405 grants to divert water for mining purposes, aggregating a total of 179,480 miner's inches. During the fiscal year 36 water rights were issued comprising 19,050 miner's inches.

Five leases have been issued to divert water for power purposes, including in all 70,000 miner's inches. The works in connection with one of these grants have been completed and are now in active operation, and the works in connection with the remaining four are under construction.

## STONE QUARRYING IN ROCKY MOUNTAINS PARK.

Seven leases have been issued for stone quarrying purposes in the Rocky Mountains Park of Canada, comprising a total area of 1,328.56 acres. The revenue derived from such leases during the year amounts to \$236.73.

Outside the park 2,285.75 acres of Dominion lands have been disposed of during the year, the revenue from which amounts to \$1,796.43.

## COAL MINING LANDS.

The regulations for the sale of coal mining lands were rescinded on the 5th of March, 1907. These regulations provided for the sale to one applicant of an area not exceeding 320 acres, at the rate of \$7 an acre for the coal mining rights only, and at the rate of \$10 an acre for the surface and coal mining rights. The regulations of the 9th of May, 1907, provide for the leasing to one applicant of the coal mining rights under an area not exceeding 2,560 acres in a compact block, at the rate of \$1 an acre per annum.

As the late regulations for the sale of coal mining lands provided for payment in four equal annual instalments, with interest, the revenue now derived from the sale of such lands is on account of the unpaid balances of the purchase price and interest only.

The total amount collected during the year on account of coal mining lands sold under the provisions of the late regulations was \$276,186.86, of which amount \$271,944.39 was on account of coal lands in the province of Alberta, \$3,578.65 on account of such lands in the province of Saskatchewan, \$96.43 on account of lands in the Railway Belt in the province of British Columbia, and \$567.39 in connection with coal lands in the Yukon Territory. The total amount collected on account of the sale of coal mining lands up to the 31st of March, 1909, was \$1,503,363.63.

The statement lettered 'D' at the end of this report shows the revenue derived from the sale of coal lands for each fiscal year since 1896.

## COAL LEASES.

The total number of coal mining leases in force at the close of the fiscal year was 175, including a total area of 84,258.90 acres, distributed as follows:—

In the province of Alberta—

- (a) Within the Rocky Mountains Park of Canada 51 leases, embracing a total area of 22,256 acres;
- (b) Outside the park, 112 leases, embracing a total area of 61,574.28 acres.

In the province of Saskatchewan 12 leases, comprising an area of 428.62 acres.

The total number of leases of coal mining rights issued during the year was 134, comprising an area of 62,032.90 acres. The total revenue received during the year for rental of coal mining rights was \$65,751.10, of which \$3,718.20 has been paid in advance on account of rental for leases applied for but not yet issued.

The following is a statement showing the revenue collected in the western provinces and in the Yukon Territory on account of the sale of coal lands during the fiscal year, under the provisions of the late regulations:—

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|   |                      |
|---|----------------------|
| Province of Alberta. . . . .                              | \$ 271,944 39        |
| Province of Saskatchewan. . . . .                         | 3,578 65             |
| Railway Belt in the province of British Columbia. . . . . | 96 43                |
| Yukon Territory. . . . .                                  | 567 39               |
| Total. . . . .  | <u>\$ 276,186 86</u> |

The revenue derived from leases to mine coal within the Rocky Mountains Park during the fiscal year amounted to \$16,252.44, and was made up as follows:—

|                                |             |
|--------------------------------|-------------|
| Rental. . . . .                | \$13,516 94 |
| Royalty on coal mined. . . . . | 2,735 50    |

The total amount of rental collected on account of such lands up to the 31st of March last was \$27,606.21, and the total amount of royalty collected up to the same date was \$18,842.

The following is a statement showing the revenue derived during the fiscal year from royalty on coal mined on Dominion lands in the western provinces (except lands in the Rocky Mountains Park) and in the Yukon Territory:—

|  |                   |
|--|-------------------|
| In the province of Alberta. . . . .      | \$2,586 89        |
| In the province of Saskatchewan. . . . . | 358 11            |
| In the Yukon Territory. . . . .          | 371 73            |
| Total. . . . .                           | <u>\$3,316 73</u> |

The total amount of royalty collected on coal mined up to the 31st of March, 1909, including that of the Rocky Mountains Park is \$30,512.82.

#### PERMISSION TO PROSPECT FOR COAL.

By an order in council, dated the 16th of February last, regulations were established for the reservation of the coal-mining rights, the property of the Crown, under an area not exceeding 2,560 acres of contiguous land, for a period of two years, for the purpose of enabling the applicant to carry on prospecting operations with the view of discovering coal. An application fee of \$100 is charged, which is applied on account of rental or refunded if failure to discover coal is satisfactorily shown. If the surface has been disposed of the applicant must furnish evidence to show that he has obtained permission from the owner of the surface to enter upon the land before the coal mining rights can be reserved for him. The applicant must expend, in actual prospecting operations by recognized methods on the tract reserved for him during each of the two years covered by the reservation the sum of at least \$1 an acre, and shall be considered the first applicant for a lease of such coal mining rights provided the conditions of the reservation have been fully complied with.

#### NEW REGISTERS.

During the year a set of township registers, showing the mineral rights that have been disposed of were opened up and completed. These registers not only show the several parcels of mining lands which have been sold or leased by the Crown, but also the lands within each of the townships affected, the surface and mining rights of which have been disposed of to railway companies as a portion of their land grant subsidy. This involved the examination and entry of 1,056 mineral, and 465 coal lands sales distributed as follows:—Total area of mineral sales 210,713.73 acres; total area of coal lands sales, 74,040.02 acres. In the province of Alberta the area of mineral sales is 199,459.51 acres, and the area of coal lands sales, 69,534.93 acres. In the province of Saskatchewan the area of mineral sales is 7,049.13 acres and the area of coal lands sales 1,000 acres. In the Railway Belt, in the province of British Columbia, the area of mineral sales is 700 acres. In the Yukon Territory the area of coal lands sales is 3,505.09 acres.

Within these townships, however, a large number of patents have been issued for the surface rights, which patents do not reserve the mines and minerals. Until these patents have been entered up in the township registers, which would involve a great deal of work, these registers cannot be said to be complete.

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A register of group lots in the Yukon Territory has also been opened, which work has already involved the examination of over 1,800 files, and the condensing of the information contained therein. While this work has not yet been completed, it is progressing satisfactorily, and when finished will be of material assistance in expediting the work of the branch, as the information contained therein will render frequent reference to the officers of the department at Dawson unnecessary, which, in the past, has been responsible for such delays as have occurred in dealing with applications in the Yukon Territory.

The following is a statement of the office work performed during the year :—

|  |        |
|--|--------|
| Letters received and recorded. . . . .   | 9,816  |
| Letters sent. . . . .  | 17,047 |
| Pages of memoranda and schedule. . . . .   | 9,145  |
| Plans and sketches prepared. . . . .   | 1,184  |
| Accounts kept posted. . . . .  | 3,935  |
| Accounts rendered. . . . .   | 6,836  |
| Assignments accepted and registered. . . . .   | 147    |
| Returns examined and posted. . . . .   | 1,316  |
| Receipts issued. . . . .   | 418    |
| Applications for coal locations received covering an approximate area of 441,440 acres. . . . .                                  | 296    |
| New entries and renewals for mining locations granted in the western provinces and territories, not including the Yukon. . . . . | 217    |
| Applications for stone, gypsum and clay. . . . .   | 26     |
| Applications for tar, asphalt and petroleum. . . . .   | 19     |
| Applications for quartz claims in Alberta and Saskatchewan. . . . .  | 231    |
| Applications for iron claims. . . . .  | 6      |
| Applications for placer mining claims in Alberta and Saskatchewan. . . . .   | 10     |
| Applications for dredging leases. . . . .  | 59     |
| Applications for homestead entry in the Yukon Territory. . . . .   | 19     |
| Homestead entries granted in the Yukon Territory. . . . .  | 17     |
| Placer mining grants, renewals and relocations in the Yukon Territory. . . . .   | 5,294  |
| Quartz mining locations granted, Yukon Territory. . . . .  | 563    |
| Applications to dredge for sand and gravel. . . . .  | 8      |
| Requisitions for patent prepared. . . . .  | 170    |
| Number of files transferred and indexed. . . . .   | 8,000  |
| Applications to purchase or lease lands in the Yukon Territory. . . . .  | 57     |
| Applications for water frontage. . . . .   | 6      |
| Agricultural leases in force in the Yukon Territory, comprising an area of 313·41 acres. . . . .                                 | 7      |
| Leases for water frontage issued. . . . .  | 1      |
| Water front leases in existence. . . . .   | 18     |
| Gold dredging leases issued. . . . .   | 14     |
| Coal mining leases issued. . . . .   | 134    |
| Timber licenses prepared. . . . .  | 114    |
| Stone quarrying leases issued. . . . .   | 1      |
| Stone quarrying leases in the Rocky Mountains Park of Canada issued, comprising a total area of 1,322·56 acres. . . . .          | 7      |

I have the honour to be, Sir,

Your obedient servant,

H. H. ROWATT,

*Chief of Branch and Secretary of the Yukon.*

9-10 EDWARD VII., A. 1910

## REVENUE OF DOMINION LANDS

A.—STATEMENT of Receipts on account of Coal and Minerals in the Provinces and Territories, Fees, Rental of Agricultural Lands, Water Power and Water Fronts, Survey Fees

| Months.        | Improvement. | Confiscated Gold Dust. | Sale of Quartz Acreage. | Yukon Homestead Fees. | Yukon Timber Dues. | Coal Mining | Mining Fees. | Yukon Hydraulic Leases. | Dredging Leases, Alberta and Saskatchewan. |
|----------------|--------------|------------------------|-------------------------|-----------------------|--------------------|-------------|--------------|-------------------------|--|
|                |              |                        |                         |                       |                    |             |              |                         |  |
| 1908.          | \$ cts.      | \$ cts.                | \$ cts.                 | \$ cts.               | \$ cts.            | \$ cts.     | \$ cts.      | \$ cts.                 | \$ cts.                                    |
| April.....     |              |                        | 33 01                   |                       | 509 46             | 2,675 06    | 4,960 00     | 956 90                  |  |
| May.....       |              |                        | 66 68                   | 10 00                 | 2,882 31           | 4,331 61    | 7,118 00     |                         | 51 00                                      |
| June.....      |              |                        | 141 33                  | 10 00                 | 2,058 98           | 2,704 45    | 11,890 75    | 150 00                  |  |
| July.....      |              |                        | 802 68                  |                       | 1,033 50           | 2,492 61    | 14,235 50    |                         | 100 00                                     |
| August.....    |              |                        | 299 48                  | 30 00                 | 1,920 86           | 1,850 18    | 7,900 00     | 300 00                  |  |
| September..... |              |                        | 101 00                  | 20 00                 | 3,053 00           | 2,912 05    | 10,266 50    | 507 00                  | 200 00                                     |
| October.....   |              |                        | 1,051 54                |                       | 4,003 68           | 27,266 53   | 12,254 25    | 337 50                  |  |
| November.....  | 135 00       |                        | 176 90                  | 10 00                 | 2,600 12           | 1,740 66    | 5,079 45     | 1,009 82                | 404 37                                     |
| December.....  |              |                        | 73 52                   |                       | 2,271 79           | 1,456 80    | 4,656 50     | 74 85                   |  |
| 1909.          |              |                        |                         |                       |                    |             |              |                         |  |
| January.....   |              |                        | 285 17                  |                       | 1,460 31           | 8,977 68    | 5,027 50     | 1,152 74                | 20 90                                      |
| February.....  |              | 75 50                  | 56 65                   |                       | 3,418 88           | 1,656 31    | 4,866 40     |                         |  |
| March.....     |              |                        | 534 80                  |                       | 1,269 75           | 13,739 39   | 4,276 50     |                         | 140 00                                     |
| Total.....     | 135 00       | 75 50                  | 3,622 76                | 80 00                 | 26,482 64          | 71,803 33   | 92,531 35    | 4,488 81                | 916 27                                     |

## SESSIONAL PAPER No. 25

## INCLUDING THE YUKON TERRITORY.

ories, also Timber, Hay, Coal, Hydraulic Mining, Dredging, Royalty on Gold, Mining and Sale of Dominion Lands in the Yukon, for the Fiscal Year 1908 and 1909.

| Dredging Leases, Yukon. | Gold Export Tax. | Free Certificates Export of Gold. | Rental, Yukon. | Registration Fees. | Hay, Yukon. | Water Power, Yukon. | Sale of Dominion Lands other than Coal, Yukon. | Stone Quarries. | Sale of Coal Lands. | Amount.    |
|-------------------------|------------------|-----------------------------------|----------------|--------------------|-------------|---------------------|--|-----------------|---------------------|------------|
| \$ cts.                 | \$ cts.          | \$ cts.                           | \$ cts.        | \$ cts.            | \$ cts.     | \$ cts.             | \$ cts.  | \$ cts.         | \$ cts.             | \$ cts.    |
| 51                      | 355 14           | 1 00                              | 5 00           | 4 50               | .....       | .....               | 267 53   | 126 84          | 14,982 10           | 24,876 85  |
| 100 00                  | 2,569 49         | 1 00                              | 4,518 50       | 2 50               | 32 00       | .....               | 585 02   | .....           | 8,843 58            | 31,111 69  |
| .....                   | 19,324 13        | 20 00                             | 2,128 85       | 6 00               | 34 00       | 250 00              | 227 77   | .....           | 13,750 67           | 52,696 93  |
| .....                   | 13,234 18        | 20 50                             | 2,077 55       | .....              | 69 00       | .....               | 176 51   | 285 00          | 15,131 24           | 49,658 27  |
| 1,350 00                | 14,074 16        | 20 00                             | .....          | .....              | 5 50        | .....               | 276 90   | 27 86           | 32,511 92           | 60,566 86  |
| 69 65                   | 14,870 54        | 66 00                             | .....          | 6 00               | .....       | .....               | 764 43   | 46              | 8,858 70            | 41,695 33  |
| 3,100 00                | 13,886 01        | 29 00                             | 2 66           | 2 00               | .....       | .....               | 627 54   | 43 15           | 4,625 00            | 67,228 86  |
| 4,000 00                | 746 05           | 1 50                              | 15 00          | 4 00               | .....       | .....               | 453 69   | .....           | 74,893 84           | 91,270 40  |
| .....                   | 2,059 90         | 2 50                              | .....          | .....              | .....       | .....               | 199 65   | 313 42          | 29,499 55           | 40,608 48  |
| 1,000 00                | 26 07            | 1 50                              | .....          | 14 00              | .....       | .....               | 60   | .....           | 9,614 87            | 27,581 34  |
| 515 65                  | 43 25            | 2 00                              | .....          | 2 00               | .....       | .....               | 544 51   | 145 00          | 43,524 78           | 54,850 93  |
| 136 46                  | 318 15           | 1 00                              | 1,080 30       | .....              | .....       | .....               | 363 37   | 201 38          | 19,950 61           | 42,011 71  |
| 10,272 07               | 81,507 07        | 166 00                            | 9,827 86       | 41 00              | 140 50      | 250 00              | 4,487 52                                       | 1,143 11        | 276,186 86          | 584,157 65 |

H. H. ROWATT,  
*Chief of Branch.*

9-10 EDWARD VII., A. 1910

## DOMINION LANDS

B.— STATEMENT showing the Total Amount of Revenue Collected at each Agency,  
Revenue received at Head Office, on account of the sale of coal lands in the Western Provinces

| Agency.  | Sale<br>of<br>Coal<br>Lands. | Sale of Dominion<br>Lands other<br>than coal, Yuc.<br>kon. | Sale of<br>Quartz<br>Acreage. | Timber<br>Dues. | Coal<br>Mining. | Mining<br>Fees. | Hydraulic<br>Leases. | Predigging<br>Leases<br>N.W.T. |
|--|------------------------------|--|-------------------------------|-----------------|-----------------|-----------------|----------------------|--------------------------------|
|  | § cts.                       | § cts.   | § cts.                        | § cts.          | § cts.          | § cts.          | § cts.               | § cts.                         |
| Banff .....                                    |                              |  |                               |                 | 13,516 94       | 4 75            |                      |                                |
| Battleford .....                               |                              |  |                               |                 | 25 00           |                 |                      |                                |
| Calgary .....                                  | 34,132 80                    |  |                               |                 | 525 25          | 140 00          |                      |                                |
| Dauphin .....                                  |                              |  |                               |                 |                 | 5 00            |                      |                                |
| Edmonton .....                                 | 32,263 78                    |  |                               |                 | 2,000 90        | 641 00          |                      |                                |
| Estevan .....                                  | 2,533 41                     |  |                               |                 | 170 00          |                 |                      |                                |
| Kamloops .....                                 |                              |  |                               |                 | 15 00           |                 |                      |                                |
| Lethbridge .....                               | 196,948 35                   |  |                               |                 | 3,480 00        | 60 00           |                      |                                |
| Moosejaw .....                                 | 125 24                       |  |                               |                 | 20 00           |                 |                      |                                |
| New Westminster .....                          | 96 43                        |  | 1,034 80                      |                 | 30 00           |                 |                      |                                |
| Prince Albert .....                            |                              |  |                               |                 |                 | 847 50          |                      |                                |
| Red Deer .....                                 | 8,599 46                     |  |                               |                 | 379 00          |                 |                      |                                |
| Winnipeg .....                                 | 920 00                       |  | 152 66                        |                 |                 | 657 50          |                      |                                |
| Ottawa .....                                   |                              |  |                               |                 | 45,574 01       | 1,347 10        | 2,341 72             | 916 27                         |
| Dawson Gold Com-<br>missioner's Office .....   |                              |  |                               |                 |                 | 71,504 50       | 2,147 09             |                                |
| Duncan Mining Re-<br>corder's Office .....     |                              |  |                               |                 |                 | 7,174 00        |                      |                                |
| Sixtymile Mining<br>Recorder's Office .....    |                              |  |                               |                 |                 | 2,008 00        |                      |                                |
| Whitehorse Asst. G.<br>Commis's Office .....   |                              |  |                               |                 |                 | 3,337 00        |                      |                                |
| Kluane Mining Re-<br>corder's Office .....     |                              |  |                               |                 |                 | 2,117 00        |                      |                                |
| Conrad Mining Re-<br>corder's Office .....     |                              |  |                               |                 |                 | 2,688 00        |                      |                                |
| Dawson Crown Tim-<br>ber Office .....          |                              |  |                               | 21,645 39       |                 |                 |                      |                                |
| Whitehorse Crown<br>Timber Office .....        |                              |  |                               | 4,836 25        |                 |                 |                      |                                |
| Dawson Comptrol-<br>ler's Office .....         |                              |  |                               |                 |                 |                 |                      |                                |
| Dawson Royalty Col-<br>lector's Office .....   |                              |  |                               |                 |                 |                 |                      |                                |
| Whitehorse Royalty<br>Collector's Office ..... |                              |  |                               |                 |                 |                 |                      |                                |
| Fortynile Royalty<br>Collector's Office .....  |                              |  |                               |                 |                 |                 |                      |                                |
| Whitehorse Compt-<br>roller's Office .....     |                              |  |                               |                 |                 |                 |                      |                                |
| Dawson Dominion<br>Lands Office .....          | 567 39                       | 1,177 71   |                               |                 |                 |                 |                      |                                |
| Dawson Mining Re-<br>corder's Office .....     |                              |  | 510 41                        |                 |                 |                 |                      |                                |
| Conrad Dominion<br>Lands Office .....          |                              |  | 1,148 11                      |                 |                 |                 |                      |                                |
| Whitehorse Domin-<br>ion Lands Office .....    |                              | 3,309 81   |                               |                 | 15 00           |                 |                      |                                |
| Whitehorse Mining<br>Recorder's Office .....   |                              |  | 776 78                        |                 |                 |                 |                      |                                |
| Totals .....                                   | 276,186 86                   | 4,487 52   | 3,622 76                      | 26,482 64       | 65,751 10       | 92,531 35       | 4,488 81             | 916 27                         |

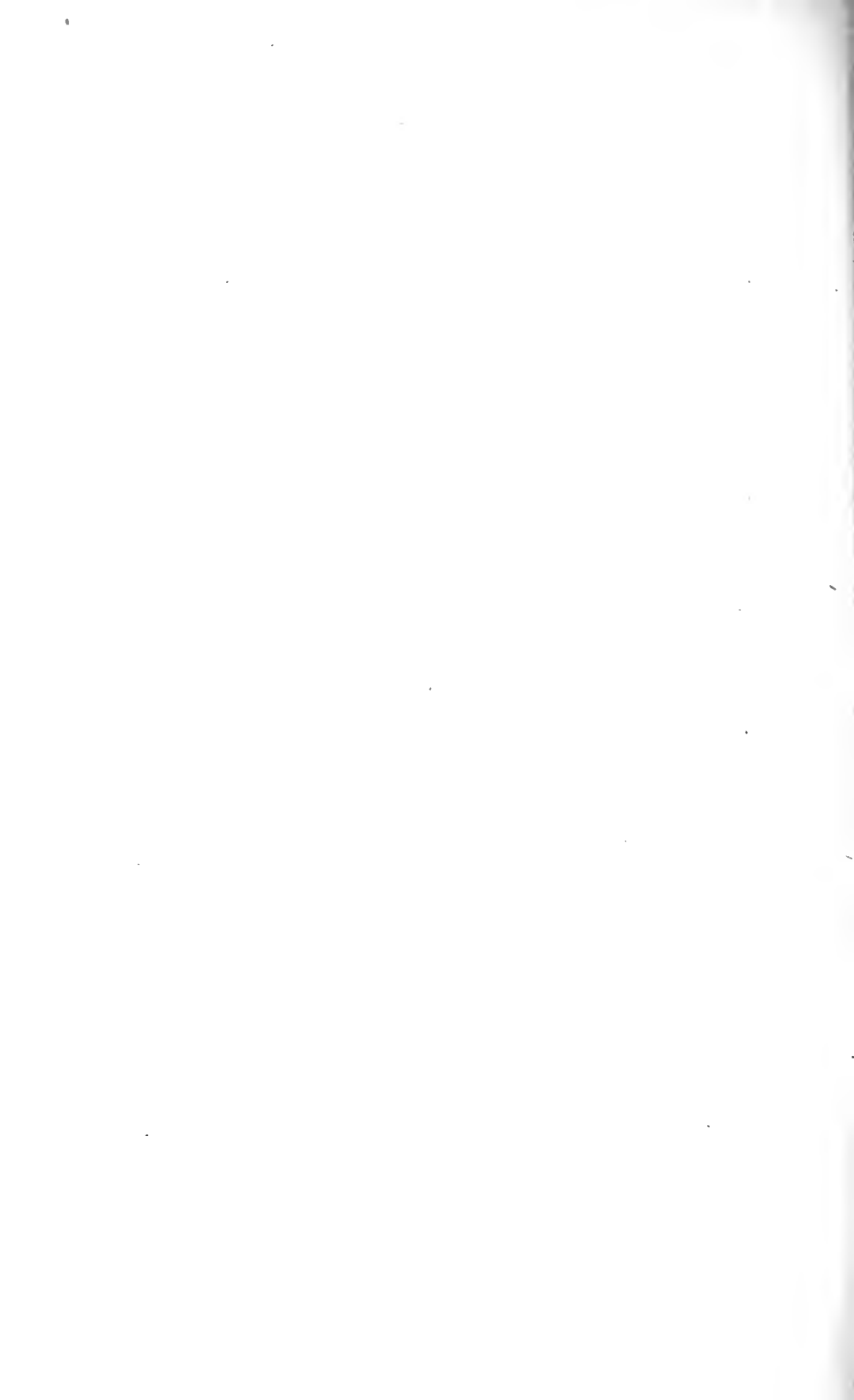
## SESSIONAL PAPER No. 25

## REVENUE.

including the Yukon Territory, for the Fiscal Year ending March 31, 1909.  
is, in this statement, credited to the several agencies in which the lands affected are situated.

| Dredging Leases<br>Yukon. | Gold<br>Export<br>Tax. | Free Certificates<br>Export of Gold. | Coal Royalty. | Rental, Yukon. | Stone Quarrying | Improvements. | Registration<br>Fees. | Homestead<br>Fees. | Confiscated<br>Gold Dust. | Hay.   | Water Power,<br>Yukon. | Amount.    |
|---------------------------|------------------------|--------------------------------------|---------------|----------------|-----------------|---------------|-----------------------|--------------------|---------------------------|--------|------------------------|------------|
| ¢ cts.                    | ¢ cts.                 | ¢ cts.                               | ¢ cts.        | ¢ cts.         | ¢ cts.          | ¢ cts.        | ¢ cts.                | ¢ cts.             | ¢ cts.                    | ¢ cts. | ¢ cts.                 | ¢ cts.     |
|                           |                        |                                      | 2,735 50      |                | 236 73          |               |                       |                    |                           |        |                        | 16,493 92  |
|                           |                        |                                      | 593 95        |                |                 |               |                       |                    |                           |        |                        | 25 00      |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 35,392 00  |
|                           |                        |                                      | 388 03        |                |                 |               |                       |                    |                           |        |                        | 5 00       |
|                           |                        |                                      | 250 25        |                |                 |               |                       |                    |                           |        |                        | 35,293 71  |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 2,933 66   |
|                           |                        |                                      | 233 47        |                |                 |               |                       |                    |                           |        |                        | 15 00      |
|                           |                        |                                      | 8 56          |                |                 |               |                       |                    |                           |        |                        | 200,721 82 |
|                           |                        |                                      |               |                | 25 00           |               |                       |                    |                           |        |                        | 153 80     |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 1,186 23   |
|                           |                        |                                      | 624 40        |                |                 |               |                       |                    |                           |        |                        | 847 50     |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 9,602 86   |
| 1,456 42                  |                        |                                      | 846 34        | 1 00           | 881 38          |               |                       |                    |                           |        |                        | 1,730 16   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        | 250 00                 | 53,614 24  |
| 8,815 65                  |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 82,467 24  |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 7,174 00   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 2,008 00   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 3,337 00   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 2,117 00   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 2,668 00   |
|                           |                        |                                      | 371 73        |                |                 |               |                       |                    |                           | 140 50 |                        | 22,158 62  |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 4,836 25   |
|                           |                        | 165 00                               |               |                |                 |               |                       |                    | 75 50                     |        |                        | 240 50     |
|                           | 79,791 02              |                                      |               |                |                 |               |                       |                    |                           |        |                        | 79,791 02  |
|                           | 1,715 30               |                                      |               |                |                 |               |                       |                    |                           |        |                        | 1,715 30   |
|                           | 75                     |                                      |               |                |                 |               |                       |                    |                           |        |                        | 75         |
|                           |                        | 1 00                                 |               |                |                 |               |                       |                    |                           |        |                        | 1 00       |
|                           |                        |                                      |               | 7,009 36       |                 | 135 00        | 34 50                 | 70 00              |                           |        |                        | 8,993 96   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 510 41     |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 1,148 11   |
|                           |                        |                                      |               | 2,817 50       |                 |               | 6 50                  | 10 00              |                           |        |                        | 6,158 81   |
|                           |                        |                                      |               |                |                 |               |                       |                    |                           |        |                        | 776 78     |
| 10,272 07                 | 81,507 07              | 166 00                               | 6,052 23      | 9,827 86       | 1,143 11        | 135 00        | 41 00                 | 80 00              | 75 50                     | 140 50 | 250 00                 | 584,157 65 |

H. H. ROWATT,  
Chief of Branch.







9-10 EDWARD VII., A. 1910

D.—STATEMENT showing the total revenue derived from the sale of coal land for each fiscal year since 1896.

| Fiscal Year.                                   | Amount. |      |
|--|---------|------|
|  | \$      | cts. |
| 1896-1897.....                                 | 75      | 76   |
| 1897-1898.....                                 | 1,833   | 74   |
| 1898-1899.....                                 | 350     | 00   |
| 1899-1900.....                                 | 5,650   | 33   |
| 1900-1901.....                                 | 101,772 | 00   |
| 1901-1902.....                                 | 16,270  | 32   |
| 1902-1903.....                                 | 31,055  | 38   |
| 1903-1904.....                                 | 68,949  | 75   |
| 1904-1905.....                                 | 35,695  | 00   |
| 1905-1906.....                                 | 125,754 | 12   |
| For the nine months ending March 31, 1907..... | 335,795 | 97   |
| 1907-1908.....                                 | 346,813 | 23   |
| 1908-1909.....                                 | 276,186 | 86   |

H. H. ROWATT  
Chief of Branch.

## YUKON REVENUE.

E.—STATEMENT showing the total Gold Production, the total subject to Royalty, and the total Royalty collected for each Fiscal Year from May 1, 1898, to March 31, 1909.

| Fiscal Year.   | Gold Production. |      | Subject to Royalty. |      | Royalty Collected. |      | Total Revenue. |      |
|----------------|------------------|------|---------------------|------|--------------------|------|----------------|------|
|                | \$               | cts. | \$                  | cts. | \$                 | cts. | \$             | cts. |
| 1897-1898..... | 3,072,773        | 20   | 2,732,928           | 20   | 273,292            | 82   | 273,292        | 82   |
| 1898-1899..... | 7,582,283        | 02   | 5,882,626           | 00   | 588,262            | 37   | 589,943        | 52   |
| 1899-1900..... | 9,809,464        | 64   | 7,307,720           | 00   | 730,771            | 99   | 733,041        | 04   |
| 1900-1901..... | 9,162,682        | 79   | 7,234,416           | 17   | 592,660            | 98   | 596,368        | 03   |
| 1901-1902..... | 9,566,340        | 52   | 8,367,225           | 88   | 331,436            | 79   | 331,532        | 04   |
| 1902-1903..... | 12,113,015       | 34   | 12,113,015          | 34   | 302,893            | 48   | 302,893        | 48   |
| 1903-1904..... | 10,790,663       | 12   | 10,790,663          | 12   | 272,217            | 90   | 272,217        | 96   |
| 1904-1905..... | 8,222,053        | 91   | 8,222,053           | 91   | 206,760            | 87   | 206,760        | 87   |
| 1905-1906..... | 6,540,007        | 09   | 6,540,007           | 09   | 163,963            | 25   | 163,963        | 25   |
| 1906-1907..... | 3,304,791        | 05   | 3,304,791           | 05   | 82,622             | 42   | 82,622         | 42   |
| 1907-1908..... | 2,820,161        | 60   | 2,820,161           | 60   | 70,504             | 65   | 70,504         | 65   |
| 1908-1909..... | 3,260,282        | 80   | 3,260,282           | 80   | 81,507             | 07   | 81,507         | 07   |
| Total.....     | 86,243,919       | 08   | 78,575,891          | 16   | 3,696,894          | 65   | 3,704,647      | 15   |

H. H. ROWATT,  
Chief of Branch.

## No. 21.

## REPORT ON TIMBER, GRAZING AND IRRIGATION.

DEPARTMENT OF THE INTERIOR,

OTTAWA, June 14, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit the report of the Timber, Grazing and Irrigation Branch for the fiscal year ending March 31, 1909.

During the year provision was made for the issue of permits in the Railway Belt in the province of British Columbia to cut fire-killed timber for the manufacture of lumber, cordwood, telegraph poles, ties and fence posts, but beyond this no amendments of importance were made to the timber or grazing regulations.

The revenue derived from timber, grazing and hay lands, and irrigation, for the fiscal year amounted to \$308,115.95, a decrease of \$202,128.15 as compared with the fiscal year ending March 31, 1908. This decrease is mainly due to the fact that during the fiscal year no timber berths were disposed of at public auction and to the depression in the lumber trade, which, however, is showing signs of renewed activity. It may be stated that during the fiscal year ending March 31, 1908, the sum of \$212,067.05 was received as bonuses on timber-berths disposed of.

Statement 'A,' showing the total revenue of the branch from its various sources, will be found at the end of this report.

Reports from the Crown timber agents at Calgary, Edmonton, Prince Albert, Winnipeg and New Westminster, showing the revenue collected on Dominion lands within their respective agencies and other information, are appended hereto. The report of the Inspector of Ranches is also attached. The report of the Commissioner of Irrigation will be found with the report of the Forestry Branch.

The total revenue from timber, grazing and irrigation received at the Crown timber agencies above mentioned, together with the ruling price of lumber and the number of mills in each agency, may be summarized as follows:—

| Agency.              | Total Revenue. | Average price of lumber per M. ft. B.M. at mills. | No. of mills operating under license. | No. of portable mills in operation. |
|----------------------|----------------|---|---------------------------------------|-------------------------------------|
|                      | \$ cts.        | \$ cts.   |                                       |                                     |
| Calgary.....         | 24,615 81      | 14 91   | 16                                    | 18                                  |
| Edmonton.....        | 22,080 26      | 13 70   | 9                                     | 17                                  |
| Prince Albert.....   | 43,229 34      | 17 54   | 6                                     | 6                                   |
| Winnipeg.....        | 93,411 58      | 14 55   | 36                                    | 21                                  |
| New Westminster..... | 55,736 25      | 14 20   | 16                                    | Nil.                                |

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Saw-mill returns received at the department give the following quantities of building material as having been manufactured and sold under government license during the year in the above mentioned agencies:—

|                                | Manufactured.                      | Sold.                              |
|--------------------------------|------------------------------------|------------------------------------|
| Sawn lumber, ft. B.M. . . . .  | 162,940,499                        | 183,375,022                        |
| Shingles . . . . .             |                                    | 10,000                             |
| Shingle bolts, cords . . . . . | 18,110 <sup>1</sup> / <sub>2</sub> | 19,226 <sup>7</sup> / <sub>8</sub> |
| Laths . . . . .                | 20,120,150                         | 31,979,210                         |

The quantity of lumber manufactured and sold within each agency will be found in the agents' reports appended hereto.

During the year 747 timber licenses were prepared, in duplicate, and issued.

The areas of timbered lands under license and permit in the provinces of Manitoba, Saskatchewan and Alberta, and within the Railway Belt in the province of British Columbia, on March 31, 1909, were as follows:—

|                            | Under License. | Under Permit. |
|----------------------------|----------------|---------------|
|                            | Sq. miles.     | Sq. miles.    |
| Manitoba . . . . .         | 1,207·83       | 710·43        |
| Alberta . . . . .          | 2,655·45       | 357·94        |
| Saskatchewan . . . . .     | 2,338·06       | 422·02        |
| British Columbia . . . . . | 2,089·00       | 23·57         |
| Total . . . . .            | 8,290·34       | 1,513·96      |

Of the above area held under permit 25·57 square miles are covered by portable saw-mill permits; 6·50 square miles by cordwood permits; and 301·96 square miles by permits issued to cut ties for railway construction purposes.

During the year there were received 296 applications to cut timber. The number of berths granted was 71, of which 21 are portable saw-mill berths. The total number of berths covered by permit is 221.

#### GRAZING LANDS.

There are 990 grazing leases in force, which cover a total area of 3,191,601·70 acres, distributed as follows:—

|  |              |
|--|--------------|
|  | Acres.       |
| Province of Manitoba . . . . .           | 6,174        |
| Province of Saskatchewan . . . . .       | 605,159      |
| Province of Alberta . . . . .            | 2,088,736    |
| Railway-Belt, British Columbia . . . . . | 491,532·70   |
| Total . . . . .                          | 3,191,601·70 |

#### IRRIGATION.

A full report of irrigation matters dealt with by this branch will be found in the report of the Superintendent of Forestry.

#### OFFICE WORK.

The following is a partial statement of the office work performed at Ottawa for the fiscal year ending March 31, 1909:—

|   |        |
|---|--------|
| Letters received and recorded . . . . .             | 20,175 |
| Letters sent . . . . .                              | 23,635 |
| Plans and sketches prepared . . . . .               | 4,704  |
| Cash receipts issued in quadruplicate . . . . .     | 1,679  |
| Timber and grazing assignments registered . . . . . | 139    |

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## TIMBER.

|  |        |
|--|--------|
| Berths applied for. . . . .  | 296    |
| Berths granted to cut railway construction timber. . . . .           | 34     |
| Portable saw-mill berths granted. . . . .                            | 21     |
| Cordwood berths granted. . . . .                                     | 14     |
| Berths granted to cut mining timber. . . . .                         | 2      |
| Licenses for timber berths prepared in duplicate. . . . .            | 747    |
| Instructions issued for survey of timber berths. . . . .             | 49     |
| Returns of survey of timber berths examined and re-examined. . . . . | 83     |
| Returns of operating saw-mills verified and posted. . . . .          | 2,532  |
| Timber permits checked and entered. . . . .                          | 10,171 |
| Ledger accounts kept posted. . . . .                                 | 968    |
| Seizures checked and entered. . . . .                                | 404    |
| Fire-guarding accounts posted. . . . .                               | 968    |

## GRAZING.

|  |       |
|--|-------|
| Applications for grazing lands received. . . . . | 479   |
| Leases of grazing lands issued. . . . .          | 161   |
| Applications for hay lands received. . . . .     | 58    |
| Ledger accounts kept posted—grazing. . . . .     | 990   |
| Ledger accounts kept posted—hay. . . . .         | 2     |
| Hay permits checked and entered. . . . .         | 1,969 |

Your obedient servant,

B. L. YORK.

## REVENUE OF DOMINION LANDS.

## A.—STATEMENT of Receipts on Account of Timber, Grazing, Hay and Irrigation for the fiscal Year ending March 31, 1909.

| Year. | Month.              | Timber.            | Grazing.  | Hay.     | Irrigation. | Total.     |           |
|-------|---------------------|--------------------|-----------|----------|-------------|------------|-----------|
|       |                     | \$ cts.            | \$ cts.   | \$ cts.  | \$ cts.     | \$ cts.    |           |
| 1908. | April . . . . .     | 24,316 98          | 2,101 61  | 1,379 40 | 23 00       | 27,820 99  |           |
|       | May . . . . .       | 30,988 65          | 3,803 83  | 941 90   | 52 75       | 35,787 13  |           |
|       | June . . . . .      | 17,074 15          | 4,506 12  | 1,187 45 | 21 25       | 22,788 97  |           |
|       | July . . . . .      | 20,477 15          | 3,697 44  | 1,813 10 | 26 50       | 26,014 19  |           |
|       | August . . . . .    | 11,391 30          | 10,068 35 | 352 15   | 16 75       | 21,828 55  |           |
|       | September . . . . . | 17,875 44          | 2,593 29  | 27 60    | 25          | 20,496 58  |           |
|       | October . . . . .   | 15,857 02          | 4,555 49  | 20 40    | 12 50       | 20,445 41  |           |
|       | November . . . . .  | 16,568 57          | 5,619 59  | 13 20    | 50 00       | 22,251 36  |           |
|       | December . . . . .  | 18,629 84          | 10,607 30 | 18 40    | 3 75        | 29,259 29  |           |
|       | 1909.               | January . . . . .  | 31,838 59 | 2,233 51 | 3 90        | 61 50      | 34,137 50 |
|       |                     | February . . . . . | 24,436 29 | 3,441 94 | 6 70        | 50 25      | 27,935 18 |
|       |                     | March . . . . .    | 15,763 04 | 3,612 16 | 17 10       | 48 50      | 19,440 80 |
|       |                     | 245,217 02         | 56,750 63 | 5,781 30 | 367 00      | 308,115 95 |           |

## Timber Dues made up as follows:

|                    |              |
|--------------------|--------------|
| Rent . . . . .     | \$ 60,171 55 |
| Royalty . . . . .  | 103,207 20   |
| Permit . . . . .   | 65,297 21    |
| Seizures . . . . . | 16,541 06    |

\$ 245,217 02

F. LOYER,

Bookkeeper, Timber, Grazing and Irrigation Branch.

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## No. 22.

## REPORT OF THE INSPECTOR OF CROWN TIMBER OFFICES.

DEPARTMENT OF THE INTERIOR,

WINNIPEG, MANITOBA, May 26, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit my annual report in connection with my work as inspector of Crown timber offices for the departmental year ended March 31, 1909.

I visited during the year all the more important offices in Manitoba, Saskatchewan, Alberta and British Columbia, and made a thorough inspection of the books and accounts. My reports regarding this work were sent forward to you as inspections were made. Where there were forest rangers attached to an office they were called in, when their work was taken up and discussed with them and the agent.

All outstanding and unsettled business was gone into, and decision reached as to the action to be taken in the endeavour to effect settlement.

Apart from royalty dues on coal mined the collections are well up and the accounts in fairly satisfactory standing.

There are a large number of expired timber permits outstanding in the books of all the offices. Notices have been sent out to the permittees time and again with but poor result. Lists have been prepared for the forest rangers, who are under instructions to make collection as opportunity offers in the round of their regular duties.

There are but few unsettled seizures. These are receiving the attention of the agents and rangers. While the timber end of the business in all of its details is not being as efficiently dealt with in some of the agencies as could be desired, it is due to the smallness of the staff employed in connection with the work.

It would be a practical impossibility to wholly put a stop to the illegal cutting of timber on the public domain, owing to scattered settlement and the wide area covered by timber. Special attention has been paid to the operations at portable saw-mills and to the cutting of timber as a speculation. The number of timber seizures made during the year in the respective agencies is shown on statement 'A' appended.

Steps are being taken to give closer supervision than has taken place in the past over the operations of the holders of timber berths by license and permit. They will be required in future to conform more strictly to all the requirements of the regulations in the matter of the keeping of bush records of their cutting, of marking the timber cut by a stamp approved by the department, and furnishing at the end of each season of cutting a ground sketch, showing the place or places where timber was cut on the berth. Regular inspections will be made of the sales records of the millmen and stock will be taken of the lumber in their possession. This work has been done in the past in some of the Crown timber agencies, but not thoroughly and systematically, as it is intended it should be carried on in the future.

## LUMBER.

The lumber industry has not recovered from the depression of two years ago, and it is claimed by the operators that the business has not been profitable.

There has been a falling off during the year of fully 15 and 20 per cent in the sales made, wholesale and retail, respectively.

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The coming season looks brighter for the trade as money is more plentiful and building is taking place in all parts of the country on an extensive scale. There is an ample supply of Canadian lumber on hand to meet all demands. The present prices are reasonable, being lower than for some years past, and it is not expected that any advance will be made unless at points free from competition.

Very little lumber is now brought in from the United States. Apart from that imported by the Grand Trunk Pacific Railway for construction purposes the amount during the past year would not exceed 7,000,000 feet, board measure, of which quantity there would be less than 1,000,000 feet of hardwoods, the balance fir, principally from the state of Washington.

The cut of logs this past year on Dominion lands has been lighter than for some years previously. The falling off occurred largely in the railway belt in British Columbia, where the millmen obtained their supply chiefly from the lands of the provincial government, the reason for this being that owing to the much heavier ground rent charged by the province for lands held under license it is cheaper to carry Dominion timber for which only a nominal ground rental is charged.

I append hereto the following summary statements, namely:—

A.—Summary of work performed at the respective offices during the year ending March 31, 1909, showing number of transactions under various heads, and amount of revenue collected.

B.—Statement showing manufacture and sale of timber products by the holders of timber berths on Dominion lands during the twelve months ended March 31, 1909.

C.—Statement showing timber material covered by permits issued at the respective agencies during the year ended March 31, 1909.

For purposes of comparison I have given the totals under the headings of each of the above statements for the previous year of 1907-8. It is quite interesting to note the changes that have taken place.

I would again respectfully draw the attention of the department to the large number of roof poles and fence rails authorized to be cut by settlers under free permits issued to them. As pointed out in my last annual report, this class of timber is not to any extent now used by the settler; sawn lumber (scantling) is almost wholly used in roofing, and posts and wire for fencing. In my opinion it would be in the public interest to withdraw the privilege from the settler of cutting this class of timber, which takes a young healthy tree in the manufacture of each piece.

Respectfully submitted,

E. F. STEPHENSON,  
*Inspector of Crown Timber Agencies.*

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STATEMENT A.—SUMMARY of Work Performed at the Respective Offices during the year ending March 31, 1909, showing Number of Transactions under Various Heads and Amount of Revenue Collected.

| Agency.                                     | Bonus. | Ground Rent. | Royalty on Timber Sales. | Timber Permits. | Timber Seizures. | Hay Permits. | Grazing Rents. | Mining Fees. | Coal Lands, Royalties, &c. | Stone Quarries. | School Lands Revenue. | Sundries. | Total Revenue for Year. |
|---|--------|--------------|--------------------------|-----------------|------------------|--------------|----------------|--------------|----------------------------|-----------------|-----------------------|-----------|-------------------------|
|   |        |              |                          |                 |                  |              |                |              |                            |                 |                       |           | \$ cts.                 |
| Battleford .....                            |        |              |                          | 356             | 11               | 110          |                |              | 7                          |                 | 130                   |           | 1,282 22                |
| Brandon .....                               |        |              |                          | 460             |                  | 26           |                |              |                            |                 | 177                   | 4         | 1,335 61                |
| Calgary .....                               |        | 26           | 31                       | 677             | 10               | 135          | 87             | 38           | 60                         |                 | 144                   |           | 27,803 97               |
| Dauphin .....                               |        |              |                          | 1,432           | 98               | 90           | 12             | 1            |                            |                 |                       |           | 16,197 71               |
| Edmonton .....                              |        | 66           | 68                       | 1,853           | 46               | 262          | 1              | 39           | 83                         |                 | not given             |           | 24,312 64               |
| Estevan .....                               |        |              |                          | 324             |                  | 283          | 34             |              | 39                         |                 |                       |           | 1,904 70                |
| Humboldt .....                              |        |              |                          | 415             |                  | 60           |                |              |                            |                 | 150                   |           | 1,042 07                |
| Kamloops .....                              |        |              |                          |                 |                  | 9            | 302            |              |                            | 3               |                       |           | 8,509 17                |
| Lethbridge .....                            |        |              |                          | 402             | 6                | 124          | 249            | not given    | not given                  |                 |                       |           | 42,602 92               |
| Moosejaw .....                              |        |              | 1                        | 756             |                  | 429          | 69             |              | 2                          | 4               |                       |           | 4,835 76                |
| New Westminster .....                       |        | 333          | 149                      | 94              | 17               |              |                |              |                            |                 |                       |           | 48,787 39               |
| Prince Albert .....                         |        | 38           | 38                       | 1,357           | 56               | 176          |                | 115          |                            |                 | not given             |           | 39,935 13               |
| Red Deer .....                              |        |              |                          | 423             | 1                | 28           |                |              | 106                        |                 | 189                   |           | 2,562 29                |
| Regina .....                                |        |              |                          | 315             | 2                | 254          | 63             |              |                            |                 |                       | 3         | 1,682 11                |
| Yorkton .....                               |        |              |                          | 568             | 2                | 89           |                |              |                            |                 | 134                   |           | 1,093 40                |
| Winnipeg .....                              |        | 112          | 132                      | 1,185           | 57               | 267          | 6              | 99           |                            |                 | 414                   | 6         | 93,705 61               |
| Totals for year ending March 31, 1909 ..... |        | 575          | 419                      | 10,617          | 306              | 2,342        | 823            | 294          | 302                        |                 | 1,479                 | 15        | 311,592 70              |
| Totals for year ending March 31, 1908 ..... | 6      | 448          | 387                      | 10,801          | 178              | 2,315        | 740            | 161          | 318                        | 11              | 1,064                 | 12        | 329,330 04              |

This statement does not account for revenue paid direct to the department at Ottawa on account of business of the agencies, which would mainly be on account of bonus and ground rent.

E. F. STEPHENSON.



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STATEMENT B.—Showing Manufacture and sale of Timber Products by Holders of Timber Berths on Dominion Lands during the twelve months ending March 31, 1909.

LICENSE.

| Agency.                                   | LUMBER, FEET—BOARD MEASURE. |             |             | LATHS.        |            | Railway Ties Manufactured. | SHINGLES.     |          |
|---|-----------------------------|-------------|-------------|---------------|------------|----------------------------|---------------|----------|
|   | Manufactured.               | On Hand.    |             | Manufactured. | On Hand.   |                            | Manufactured. | On Hand. |
|   |                             | Sold.       |             |               |            |                            |               |          |
| Calgary.....                              | 13,730,588                  | 11,211,737  | 10,012,964  |               |            | 9,681                      |               |          |
| Edmonton.....                             | 9,679,117                   | 7,112,690   | 8,304,652   | 1,332,430     | 1,311,380  | 8,089                      |               |          |
| New Westminster.....                      | 53,323,157                  | 54,621,244  | 28,718,487  | 1,189,500     | 983,250    |                            | 18,110½       |          |
| Prince Albert.....                        | 39,435,674                  | 48,734,960  | 20,670,864  | 7,810,470     | 12,352,030 | 25,000                     | 19,226½       | 6,148½   |
| Winnipeg.....                             | 46,171,963                  | 61,694,391  | 43,518,001  | 9,787,750     | 17,332,550 | 138,036                    |               | Bolts.   |
| Total for year ending March 31, 1909..... | 162,940,499                 | 183,375,022 | 112,224,968 | 20,120,150    | 31,979,210 | 180,806                    | 18,110½       | 19,226½  |
| Total for year ending March 31, 1908..... | 267,532,730                 | 180,909,384 | 139,805,143 | 29,551,839    | 17,069,889 | 1,540,674                  | 9,519½        | 7,597½   |
|   |                             |             |             |               | 22,361,860 |                            |               | 6,148½   |
|   |                             |             |             |               |            |                            |               | 7,390½   |

PERMIT.

|                      |            |            |           |  |  |         |         |         |
|----------------------|------------|------------|-----------|--|--|---------|---------|---------|
| Calgary.....         | 7,210,191  | 5,456,779  | 2,508,646 |  |  | 92,507  |         |         |
| Edmonton.....        | 5,971,499  | 4,455,063  | 4,822,107 |  |  | 26,798  |         |         |
| New Westminster..... | Nil        | Nil        | Nil       |  |  |         | 296,000 | 208,000 |
| Prince Albert.....   | 397,960    | 209,679    | 188,281   |  |  |         |         |         |
| Winnipeg.....        | 5,289,311  | 5,631,695  | 2,317,168 |  |  |         |         |         |
|                      | 18,868,961 | 15,753,216 | 9,926,192 |  |  | 136,183 | 296,000 | 208,000 |
|                      |            |            |           |  |  |         |         | 88,000  |

E. F. STEPHENSON.

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STATEMENT C.—TIMBER MATERIAL COVERED BY PERMITS ISSUED AT THE RESPECTIVE AGENCIES DURING THE YEAR ENDING MARCH 31, 1909.

| Agency.                                   | Lumber<br>and Logs,<br>Feet, B.M. | Roof Poles. | Fence Posts. | Fence Rails. | Cardwood,<br>Cords. | Mine<br>Props. | Shingles.                    | Railwa<br>Ties. |
|---|-----------------------------------|-------------|--------------|--------------|---------------------|----------------|------------------------------|-----------------|
| Battleford.....                           | 2,494,689                         | 76,140      | 99,806       | 371,700      | 3,595               |                |                              |                 |
| Brandon.....                              | 249,930                           | 7,135       | 2,880        | 100          | 6,924               |                |                              |                 |
| Calgary.....                              | 5,989,847                         | 297,458     | 251,643      | 1,124,701    | 16,616              |                |                              |                 |
| Dauphin.....                              | 3,305,987                         | 22,200      | 70,800       | 75,200       | 8,757               |                | 15,000                       |                 |
| Edmonton.....                             | 9,960,236                         | 372,892     | 438,236      | 1,855,330    | 1,089               |                | 36,000                       | 596,750         |
| Estevan.....                              | 658,220                           | 41,350      | 40,870       | 66,325       | 4,155               |                |                              |                 |
| Humboldt.....                             | 3,086,686                         | 38,210      | 46,885       | 50,730       | 1,026               |                |                              |                 |
| *Kamloops.....                            | Nil.                              | Nil.        | Nil.         | Nil.         | Nil.                | Nil.           | Nil.                         |                 |
| Leithbridge.....                          | 2,918,677                         | 138,870     | 153,317      | 718,867      | 4,099               | 3,000          |                              |                 |
| Moosejaw.....                             | 3,150,000                         | 197,296     | 273,754      | 886,080      | 7,089               |                |                              |                 |
| New Westminster.....                      | 3,287,819                         | 450         | 2,250        |              | 1,299½              |                |                              |                 |
| Prince Albert.....                        | 5,816,685                         | 185,882     | 899,012      | 392,408      | 18,341              |                |                              | 4,902           |
| Red Deer.....                             | 2,995,946                         | 80,562      | 109,325      | 496,215      | 5,697               |                |                              |                 |
| Regina.....                               | 834,000                           | 52,075      | 57,850       | 78,000       | 3,320               |                |                              |                 |
| Yorkton.....                              | 3,281,515                         | 76,687      | 91,785       | 326,405      | 3,121               |                |                              |                 |
| Winnipeg.....                             | 2,108,221                         | 23,640      | 61,526       | 68,350       | 29,935              |                |                              |                 |
| Total for year ending March 31, 1909..... | 50,152,088                        | 1,520,847   | 2,579,443    | 6,329,020    | 106,036½            | 3,000          | 51,000<br>+ Crds, bolts, 923 | 601,652         |
| Total for year ending March 31, 1908..... | 57,170,935                        | 1,654,940   | 2,831,928    | 6,522,425    | 190,292½            |                |                              |                 |

E. F. STEPHENSON.

\* Timber business for Kamloops Agency transacted at New Westminster office.

## No. 23.

## REPORT OF THE CROWN TIMBER AGENT AT WINNIPEG.

DEPARTMENT OF THE INTERIOR,  
CROWN TIMBER OFFICE,

WINNIPEG, MANITOBA, May 26, 1909.

J. W. GREENWAY, Esq.,  
Commissioner of Dominion Lands,  
Ottawa.

SIR.—I have the honour to submit my report upon the Timber and Grazing Branch of the department for the year ending March 31, 1909, to which are appended the following classified statements:—

A.—Classified statement showing revenue collected on account of Dominion lands for timber, grazing and hay permits during the year.

B.—Schedule giving list of names of the respective holders of timber berths held under license who are conducting operations, and the extent thereof.

C.—Schedule showing the mills (including portable mills) operated within the Winnipeg agency under government permits.

D.—Schedule, being general office return of the Crown timber agency, Winnipeg.

## LUMBER SALES.

The statement given hereunder, showing the amount of lumber and other products of timber sold within this district, exclusive of imports from the United States, was compiled from particulars procured from reliable sources, and may be accepted as approximately correct:—

|  | 1907-08.<br>Feet B.M. | 1908-09.<br>Feet B.M. |
|--|-----------------------|-----------------------|
| From province of Ontario, west of Lake Superior— |                       |                       |
| From Canadian logs. . . . .                      | 58,000,000            | 51,000,000            |
| From American logs. . . . .                      | 50,000,000            | 40,000,000            |
| From province of British Columbia. . . . .       | 92,000,000            | 100,000,000           |
| From mills operating under Dominion license      | 53,485,361            | 61,694,391            |
| From mills operating under Dominion permit       | 13,500,000            | 5,631,695             |

For purposes of comparison I give hereunder the selling price of the different classes of lumber during the year which ended on March 31, 1908, with that for the year ended March 31, 1909.

| <i>Pine, cedar and fir—</i>           | 1907-08.   |              | 1908-09.   |              |
|---------------------------------------|------------|--------------|------------|--------------|
|                                       | Per        | M. feet B.M. | Per        | M. feet B.M. |
| Dimension lumber. . . . .             | \$18 00 to | \$25 00      | \$18 00 to | \$25 00      |
| Fir for interior finishing. . . . .   | 40 00 to   | 50 00        | 40 00 to   | 50 00        |
| Flooring, siding and ceiling. . . . . | 33 00 to   | 40 00        | 33 00 to   | 40 00        |
| Shiplap and common boards. . . . .    | 21 00 to   | 23 00        | 20 00 to   | 23 00        |

*Spruce—*

|                                       |            |         |            |         |
|---------------------------------------|------------|---------|------------|---------|
| Dimension lumber. . . . .             | \$18 00 to | \$25 00 | \$18 00 to | \$20 00 |
| Siding, flooring and ceiling. . . . . | 23 00 to   | 28 00   | 23 00 to   | 28 00   |
| Shiplap and common boards. . . . .    | 18 00 to   | 24 00   | 18 00 to   | 24 00   |
| Lath. . . . .                         | 4 00 to    | 5 00    | 3 75 to    | 5 00    |
| Shingles. . . . .                     | 3 00 to    | 3 65    | 2 70 to    | 3 00    |

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The figures given hereunder give approximately the sales of coal and wood during the same year:—

|                               | 1907-08.<br>Tons. | 1908-09.<br>Tons. |
|-------------------------------|-------------------|-------------------|
| American anthracite.. . . . . | 140,000           | 145,000           |
| American bituminous.. . . . . | 150,000           | 150,000           |
| Canadian anthracite.. . . . . | 40,000            | 42,000            |
| Canadian bituminous.. . . . . | 61,731            | 73,800            |
| Canadian lignite.. . . . .    | 120,000           | 146,000           |
| Total.... . . . .             | 511,731           | 556,800           |

These figures are exclusive of coal used in connection with the operations of the railroads.

The following retail prices were obtained at Winnipeg:—

|                                 | 1907-08.<br>Per Ton. | 1908-09.<br>Per Ton. |
|---------------------------------|----------------------|----------------------|
| American anthracite.... . . . . | \$10 50              | \$10 50              |
| American bituminous.. . . . .   | 8 00 to \$8 50       | 7 00 to \$8 50       |
| Canadian anthracite.. . . . .   | 10 00                | 10 00                |
| Canadian bituminous.. . . . .   | 8 00 to 9 00         | 8 00                 |
| Canadian lignite.. . . . .      | 5 00 to 5 50         | 5 00 to 5 50         |

#### CORDWOOD.

The sales of cordwood in the city of Winnipeg and town of St. Boniface during the year amounted to about 98,000 cords. The retail price charged per cord was for poplar, \$2.75 to \$3.75; spruce and jackpine, from \$4 to \$4.75, and tamarack, from \$5.50 to \$6.

The wood was principally taken from Dominion and provincial lands under the authority of permits.

#### REVENUE.

The total revenue collected from all sources at this office during the year amounts to \$127,949.83, made up as follows:—From Dominion Lands Branch, \$30,846.09; Crown Timber Branch, \$90,057.57, and from school lands, \$6,232.96.

The revenue from mines for the same period amounted to \$805.16.

The increase in revenue derived from timber, grazing and mines over the preceding year amounts to the sum of \$14,884.85.

#### TIMBER PERMITS.

The number of timber permits issued to settlers from this office during the year was 989, including 30 on school lands, covering the following quantity of timber.

For purposes of comparison I likewise give the quantities for previous year under the heading of seizures.

##### *Dominion Lands—*

|                                      | 1907-8.   | 1908-9.   |
|--------------------------------------|-----------|-----------|
| Building logs (lineal ft.).. . . . . | 318,071   | 290,837   |
| Lumber (ft. B.M.).. . . . .          | 1,131,244 | 1,235,710 |
| Roof poles.. . . . .                 | 35,885    | 23,640    |
| Fence rails.. . . . .                | 94,635    | 68,350    |
| Fence posts.. . . . .                | 77,976    | 61,520    |
| Cordwood.. . . . .                   | 51,082    | 20,419    |

##### *School Lands—*

|                                      |       |      |
|--------------------------------------|-------|------|
| Building logs (lineal ft.).. . . . . | 600   | Nil. |
| Cordwood.. . . . .                   | 2,820 | 516  |

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## SEIZURES.

During the year 63 seizures were made covering timber cut on Dominion lands, including 6 seizures on school lands, as follows:—

| <i>Dominion Lands—</i>               | 1907-8. | 1908-9.   |
|--------------------------------------|---------|-----------|
| Building logs (lineal ft.) . . . . . | 8,436   | 43,365    |
| Lumber (ft. B.M.) . . . . .          | 205,365 | 1,678,572 |
| Railway ties . . . . .               | 4,685   | 35,634    |
| Fence posts . . . . .                | 700     | 17,593    |
| Cordwood . . . . .                   | 1,673   | 2,640½    |
| Telegraph poles . . . . .            | Nil.    | 48        |
| <i>School Lands—</i>                 |         |           |
| Lumber (ft. B.M.) . . . . .          | 1,000   | 20,000    |
| Railway ties . . . . .               | 1,423   | 2,795     |
| Fence posts . . . . .                | 350     | 300       |
| Cordwood . . . . .                   | 193     | Nil.      |
| Telegraph poles . . . . .            | 185     | Nil.      |

## HAY.

The number of settlers acquiring permits to cut hay upon Dominion and school lands was 600, aggregating 12,736 tons. During the previous year 738 permits were issued, covering 16,108 tons of hay.

## FOREST FIRES.

Very little damage to the timber from fire was reported during the year. Greater care is being exercised by the public in regard to setting out fires to keep them under control, due in a large measure to the action being taken by the Forestry Branch to post the settlers in the law, and to enforce it against trespassers.

Your obedient servant,

E. F. STEPHENSON,  
*Crown Timber Agent.*

SCHEDULE A.—STATEMENT of receipts from Crown Timber Agency at Winnipeg for fiscal year ending March 31, 1909.

| Month.                   | Bonus under License. |      | Ground Rent under License. |      | Royalty Dues under License. |      | Permit Fees, Dues and Rental. |      | Seizures. |      | Grazing Lands Rentals. |      | Hay Permits, Fees and Dues. |      | Totals. |      |
|--------------------------|----------------------|------|----------------------------|------|-----------------------------|------|-------------------------------|------|-----------|------|------------------------|------|-----------------------------|------|---------|------|
|                          | %                    | cts. | %                          | cts. | %                           | cts. | %                             | cts. | %         | cts. | %                      | cts. | %                           | cts. | %       | cts. |
| 1908.                    |                      |      |                            |      |                             |      |                               |      |           |      |                        |      |                             |      |         |      |
| April                    |                      |      | 541                        | 64   | 1,514                       | 18   | 1,434                         | 08   | 848       | 26   |                        |      | 195                         | 30   | 4,533   | 46   |
| May                      |                      |      | 413                        | 15   | 1,837                       | 62   | 5,472                         | 85   | 161       | 64   |                        |      | 51                          | 30   | 7,936   | 56   |
| June                     |                      |      | 1,636                      | 03   | 3,025                       | 28   | 2,435                         | 36   | 362       | 78   |                        |      | 71                          | 35   | 7,530   | 80   |
| July                     |                      |      | 495                        | 76   | 1,589                       | 46   | 534                           | 16   |           |      | 4                      | 15   | 199                         | 15   | 2,822   | 98   |
| August                   |                      |      | 1,577                      | 35   | 1,900                       | 58   | 1,375                         | 83   | 173       | 56   |                        |      | 21                          | 00   | 5,248   | 32   |
| September                |                      |      | 376                        | 87   | 3,618                       | 23   | 8,297                         | 18   | 274       | 48   | 1                      | 20   | 4                           | 00   | 12,571  | 96   |
| October                  |                      |      | 1,081                      | 24   | 3,548                       | 33   | 1,101                         | 61   | 2,014     | 53   | 3                      | 20   | 11                          | 00   | 7,739   | 91   |
| November                 |                      |      | 660                        | 15   | 397                         | 19   | 1,389                         | 48   |           |      |                        |      |                             |      | 2,446   | 73   |
| December                 |                      |      |                            |      | 1,671                       | 79   | 4,801                         | 39   | 32        | 60   | 1                      | 60   | 1                           | 00   | 9,508   | 38   |
| 1909.                    |                      |      |                            |      |                             |      |                               |      |           |      |                        |      |                             |      |         |      |
| January                  |                      |      | 439                        | 45   | 7,319                       | 03   | 7,193                         | 00   | 892       | 73   |                        |      |                             |      | 15,844  | 21   |
| February                 |                      |      | 4                          | 50   | 5,786                       | 28   | 750                           | 15   | 631       | 80   |                        |      | 0                           | 40   | 7,163   | 13   |
| March                    |                      |      | 299                        | 40   | 2,812                       | 62   | 2,176                         | 29   | 1,381     | 92   | 4                      | 45   |                             |      | 6,677   | 68   |
| Totals                   |                      |      | 7,525                      | 54   | 38,040                      | 50   | 37,131                        | 38   | 6,797     | 30   | 14                     | 90   | 554                         | 50   | 90,064  | 12   |
| Collected at head office |                      |      | 3,176                      | 40   | 111                         | 06   |                               |      | 60        | 00   |                        |      |                             |      | 8,347   | 46   |
|                          |                      |      | 10,701                     | 94   | 38,151                      | 56   | 37,131                        | 38   | 6,837     | 30   | 14                     | 90   | 554                         | 50   | 93,411  | 58   |

NOTE.—Less \$4 55, amount paid on account ground rent berth No. 903, transferred to School Lands Branch.

E. F. STEPHENSON,  
Crown Timber Agent.







SESSIONAL PAPER No. 25

SCHEDULE C.—Showing the Mills (including the Portable Mills) operating within the Winnipeg Agency, under Government Permits, for the Fiscal Year ending March 31, 1909.

| No.                 | Mill Owner.  | Location of Mill.                   | Berth No. | Species of Timber Cut.                        | LUMBER.                        |                   |                      | LOG COUNT. |                         |                  | Average Log Ft. B. M. |
|---------------------|--|-------------------------------------|-----------|---|--------------------------------|-------------------|----------------------|------------|-------------------------|------------------|-----------------------|
|                     |  |                                     |           |   | Manu-<br>factured<br>Ft. B. M. | Sold<br>Ft. B. M. | On hand<br>Ft. B. M. | Logs Cut.  | Logs Manufac-<br>tured. | Logs on<br>hand. |                       |
| 1                   | Blackburn & Somerville.....                                | 27-32-20 W 1.....                   | 1508      | Tamarack and spruce.....                      | 385,000                        | 185,200           | 200,000              | 7,295      | 7,295                   | 7,295            | 52                    |
| 2                   | Batson, W. F.....  | 27-39-25 W 1.....                   | 1519      | Spruce.....                                   | 293,200                        | 268,200           | 25,000               | 4,495      | 4,495                   | 4,495            | 65                    |
| 3                   | Fulton, Thos.....  | Etoimami.....                       | 1345      | "   | 126,650                        | 126,650           | 223,170              | 3,103      | 1,666                   | 1,437            | 82                    |
| 4                   | Gamache, Pierre.....                                       | 9-23-2 W 1.....                     | 1531      | "   | 137,000                        | 125,000           | 12,000               | 2,000      | 2,000                   | 2,000            | 37                    |
| 5                   | Hall, Erick.....   | 24-18-18 W 1.....                   | 1483      | "   | 75,775                         | 91,739            | 40,000               | 5,500      | 5,500                   | 5,500            | 25                    |
| 6                   | Heale, Walter G.....                                       | 2-29-1 E 1.....                     | S. 42     | "   | 22,500                         | 32,500            | 900                  | 1,600      | 1,600                   | 1,600            | 43                    |
| 7                   | Helgason, Johannes.....                                    | 20-23-4 E 1.....                    | 1509      | Tamarack and spruce.....                      | 70,000                         | 50,000            | 20,000               | 900        | 900                     | 900              | 70                    |
| 8                   | Hodgins, Alex.....   | 19-22-6 W 1.....                    | 1550      | Spruce.....                                   | 35,000                         | 30,000            | 5,000                | 6,200      | 6,200                   | 6,200            | 24                    |
| 9                   | Hodgins, Alex.....   | 30-22-6 W 1.....                    | 1572      | Tamarack, spruce, jackpine<br>and poplar..... | 150,000                        | 150,000           | 31,000               | 4,215      | 670                     | 3,545            | 46                    |
| 10                  | Klneec, C. R.....  | 27-28-23 W 1.....                   | S. L. 61  | Tamarack and spruce.....                      | 31,320                         | 320               | 116,270              | 3,323      | 40                      | 3,283            | 55                    |
| 11                  | Loewen, C. T.....  | Steinbach.....                      | 1568      | "   | 120,000                        | 170,000           | 170,000              | 250        | 2,000                   | 2,000            | 60                    |
| 12                  | Marchanski, J.....   | Net Point.....                      | 1576      | "   | 55,000                         | 35,000            | 20,000               | 6,000      | 1,500                   | 4,500            | 36                    |
| 13                  | McDougall, Alex.....                                       | 19-23-11 W 1.....                   | 1585      | Spruce and poplar.....                        | 25,000                         | 75,000            | 3,000                | 1,200      | 500                     | 3,200            | 26                    |
| 14                  | McHaffie, Peter.....                                       | 4-38-27 W 1.....                    | 1421      | Tamarack and spruce.....                      | 85,600                         | 168,600           | 3,000                | 3,973      | 2,500                   | 2,500            | 33                    |
| 15                  | McHaffie, Peter.....                                       | 4-38-27 W 1.....                    | 1575      | "   | 83,667                         | 83,667            | 91,950               | 3,973      | 3,973                   | 3,973            | 33                    |
| 16                  | Oddleifson, Gestur.....                                    | 1-21-2 E 1.....                     | 1375      | Spruce and poplar.....                        | 134,150                        | 119,578           | 91,950               | 2,600      | 2,600                   | 2,600            | 38                    |
| 17                  | Pratt, B. M.....   | 16-33-28 W 1.....                   | 1482      | Tamarack, spruce and jack-<br>pine.....       | 100,000                        | 100,000           | 630,120              | 52,654     | 44,882                  | 16,872           | 42                    |
| 18                  | Thompson, B. B.....  | 9-24-6 E 1.....                     |           |   | 1,919,482                      | 1,967,784         |                      |            |                         |                  |                       |
| 19                  | Thompson, J. H.....  | 23-23-4 E 1.....                    |           |   |                                |                   |                      |            |                         |                  |                       |
| 20                  | Tyler, D. C.....   | 19-18-15 W 1.....                   |           |   |                                |                   |                      |            |                         |                  |                       |
| 21                  | Walstrom, V.....   | 26-18-17 W 1.....                   |           |   |                                |                   |                      |            |                         |                  |                       |
| PERMIT BERTHS ONLY. |  |                                     |           |   |                                |                   |                      |            |                         |                  |                       |
| 1                   | Burrows, T. A.....   | Garland.....                        | 827       | Spruce.....                                   | 153,200                        | 153,200           | 1,503,590            | 9,400      | 2,850                   | 9,400            | 53                    |
|                     | Caverly, Jefferson.....                                    | Boysman River,<br>27-38-28 W 1..... | 966       | "   | 1,577,911                      | 2,035,441         |                      | 40,927     | 34,577                  | 5,450            | 45                    |
| 3                   | Matthews, B. J.....  | Siglines.....                       | 1090      | "   | 120,000                        | 40,000            | 80,000               | 11,000     | 2,500                   | 11,500           | 48                    |
| 4                   | McArthur, J. D.....  | Lac du Bonnet.....                  | 872       | Tamarack, spruce and poplar.....              | 23,316                         | 23,316            | 103,448              | 3,000      | 3,000                   | 3,000            | 34                    |
| 5                   | McArthur, J. D.....  | Black River.....                    | 793       | "   | 103,448                        | 771,374           | 23,140               | 23,140     | 23,140                  | 23,140           | 33                    |
| 6                   | Robinson, Wm.....  | Big Grindstone<br>Pt.....           | 830       | Tamarack and spruce.....                      | 771,374                        | 620,580           |                      | 14,475     | 14,475                  | 14,475           | 42                    |
| 7                   | Wells, A. L., assigned to J.<br>A. Dart, Oct. 7, 1908..... |                                     | 1044      | Spruce.....                                   | 620,580                        | 620,580           | 1,687,038            | 60,427     | 80,542                  | 26,350           |                       |
|                     |  |                                     |           |   | 3,369,829                      | 3,663,911         |                      |            |                         |                  |                       |

SCHEDULE C.—Showing the Mills (including the Portable Mills) operating within the Winnipeg Agency, &c.—*Concluded.*  
PORTABLE SAW-MILL BERTHS ONLY.—*Concluded.*

| No. | Mill Owner.             | Location of Mill. | Berth No. | Species of Timber Cut.                  | RAILWAY TIES.   |       | Average price of Lumber per M. ft. | No. of Returns made. | Date of last Return. | Remarks.                  |
|-----|-------------------------|-------------------|-----------|---|-----------------|-------|------------------------------------|----------------------|----------------------|---------------------------|
|     |                         |                   |           |   | Mann-ufactured. | Sold. |                                    |                      |                      |                           |
| 1   | Blackburn & Somerville. | 27-32-20 W 1.     | 1508      | Tamarack and spruce.                    |                 |       | \$ 16 00                           | 4                    | Mar. 31, '09         |                           |
| 2   | Batson, W. F.           | 27-39-25 W 1.     | 1519      | Spruce.                                 |                 |       | 11 62                              | 4                    | " 31, '09            |                           |
| 3   | Fulton, Thos.           | Etomani.          | 1345      | "                                       |                 |       | 20 00                              | 4                    | " 31, '09            |                           |
| 4   | Gamache, Pierre.        | 9-23-2 W 1.       | 1631      | "                                       |                 |       | 13 00                              | 3                    | " 31, '09            |                           |
| 5   | Hall, Erick.            | 24-18-18 W 1.     | 1483      | "                                       |                 |       | 11 00                              | 4                    | " 31, '09            |                           |
| 6   | Hale, Walter G.         | 2-20-1 E 1.       | S. L. 42  | "                                       |                 |       | 15 00                              | 3                    | Dec. 26, '08         | Cancelled, Dec. 26, 1908. |
| 7   | Helgeson, Johannes.     | 20-23-4 E 1.      | 1509      | Tamarack and spruce.                    |                 |       | 16 00                              | 1                    | Mar. 31, '09         |                           |
| 8   | Hodgins, Alex.          | 19-22-6 W 1.      | 1373      | Spruce.                                 |                 |       | 15 00                              | 2                    | May 31, '08          | Cancelled, June 18, 1908. |
| 9   | Hodgins, Alex.          | 30-22-6 W 1.      | 1530      | "                                       |                 |       | 12 00                              | 1                    | " 31, '09            |                           |
| 10  | Kinnee, C. R.           | 27-28-23 W 1.     | 1572      | Tamarack, spruce, jack-pine and poplar. |                 |       | 20 00                              | 3                    | " 31, '09            |                           |
| 11  | Loewen, C. T.           | Steinbach         | S. L. 61  | Tamarack and spruce.                    |                 |       | 15 00                              | 2                    | " 31, '09            |                           |
| 12  | Marchanski, J.          | Net Point         | 1542      | Spruce.                                 |                 |       | 10 00                              | 1                    | " 31, '09            |                           |
| 13  | McDougall, Alex.        | 19-33-11 W 1.     | 1668      | "                                       |                 |       | 15 00                              | 3                    | Dec. 31, '08         | Cancelled, Oct. 21, 1908. |
| 14  | McHaffie, Peter.        | 4-38-27 W 1.      | S. L. 41  | "                                       |                 |       | 15 00                              | 1                    | Mar. 31, '09         |                           |
| 15  | McHaffie, Peter.        | 4-38-27 W 1.      | 1576      | "                                       |                 |       | 15 00                              | 3                    | " 31, '09            |                           |
| 16  | Oddleifsson, Gestur.    | 1-21-2 E 1.       | 1559      | "                                       |                 |       | 15 00                              | 1                    | " 31, '09            |                           |
| 17  | Pratt, B. M.            | 16-33-28 W 1.     | 1385      | Spruce and poplar.                      |                 |       | 14 33                              | 4                    | June 30, '08         | Cancelled, Aug. 25, 1908. |
| 18  | Thompson, B. B.         | 9-24-6 E 1.       | 1421      | Tamarack and spruce.                    |                 |       | 15 00                              | 1                    | Mar. 31, '09         |                           |
| 19  | Thompson, J. H.         | 23-23-4 E 1.      | 1348      | "                                       |                 |       | 12 00                              | 4                    | June 30, '08         | Cancelled, July 13, 1908. |
| 20  | Tyler, D. C.            | 19-18-15 W 1.     | 1375      | Spruce and poplar.                      |                 |       | 13 33                              | 4                    | " 31, '09            |                           |
| 21  | Walstrom, V.            | 26-18-17 W 1.     | 1482      | Tamarack, spruce and jackpine.          |                 |       |                                    |                      |                      |                           |

| PERMIT BERTHS ONLY.— <i>Concluded.</i> |   |                    |           |                           |
|--|---|--------------------|-----------|---------------------------|
| No.                                    | Mill Owner.   | Location of Mill.  | Berth No. | Species of Timber Cut.    |
| 1                                      | Burrows, T. A.                                      | Garland            | 827       | Spruce.                   |
| 2                                      | Caverly, Jefferson                                  | Bowsman River.     | 966       | "                         |
| 3                                      | Matthews, B. J.                                     | 27-36-28 W 1.      | 1090      | "                         |
| 4                                      | McArthur, J. D.                                     | Siglunes.          | 872       | Tamarack, spruce & poplar |
| 5                                      | McArthur, J. D.                                     | Lac du Bonnet.     | 293       | "                         |
| 6                                      | Robinson, Wm.                                       | Black River        | 830       | Tamarack and spruce.      |
| 7                                      | Wells, A. L., assigned to J. A. Dart, Oct. 7, 1908. | Big Grindstone Pt. | 1044      | Spruce.                   |

E. F. STEPHENSON, Crown Timber Agent.

SESSIONAL PAPER No. 25

## SCHEDULE D.—GENERAL Office Return of the Crown Timber Agency, Winnipeg, for Fiscal Year ending March 31, 1909.

| Particulars.  | Number,<br>&c. | As compared with previous year. |            | Remarks.   |
|---|----------------|---------------------------------|------------|--|
|   |                | Increase.                       | Decrease.  |  |
| Letters received.....                               | 24,382         | 5,048                           |            | ) Includes Land Department;<br>no separate record kept.        |
| Letters written.....                                | 22,130         | 2,978                           |            |  |
| Permits subject to dues issued.....                 | 305            |                                 | 426        |  |
| Free permits issued.....                            | 684            |                                 | 18         |  |
| Seizures made.....                                  | 63             | 14                              |            |  |
| Mill returns received and verified.....             | 584            | 17                              |            |  |
| Mills operating under government license.....       | 36             | 1                               |            |  |
| " " " permits.....                                  | 22             |                                 |            | Permit berths not included in<br>return previous to this year. |
| Quantity of lumber manufactured, under license..... | 46,171,963     |                                 | 35,405,367 |  |
| Quantity of lumber sold, under license.....         | 61,694,391     | 8,209,030                       |            |  |
| " " on hand ".....                                  | 43,518,001     |                                 | 18,002,621 |  |
| Average price at which lumber sold. Per M.          | \$14.55        |                                 | \$3.45     |  |
| Hay permits issued.....                             | 600            |                                 | 138        |  |

E. F. STEPHENSON,  
*Crown Timber Agent.*

## No. 24.

## REPORT OF THE CROWN TIMBER AGENT AT CALGARY.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS AND CROWN TIMBER OFFICE.  
CALGARY, ALBERTA, May 14, 1909.

The Commissioner of Dominion Lands,  
Ottawa.

SIR,—I have the honour to inclose herewith the following statements for the twelve months ending March 31, 1909:—

Schedule 'A,' statement on account of Crown timber, grazing and hay lands. The amount collected at the office and at headquarters on account of this agency is \$24,615.81.

Schedule 'B,' showing the saw-mills within the Crown timber agency in operation under government license.

Schedule 'C,' showing the portable saw-mills operated under permit.

Schedule 'D,' general office work.

Schedule 'F,' showing quantity of timber cut under settlers' permits, &c.

You will observe that the quantity manufactured from licensed berths during the twelve months, amounted to 13,730,588 ft. B.M., quantity sold 11,211,737 ft. B.M.; manufactured by portable mills under permits, 7,210,191 ft. B.M.; quantity sold, 5,476,799 ft.; total quantity on hand 13,611,610 ft.

In addition to the 20,940,779 ft board measure manufactured as above mentioned, there has probably been about 100,000,000 ft. brought into this province from the province of British Columbia, but apparently nothing has been imported from the United States.

9-10 EDWARD VII., A. 1910

The log crop according to an estimate made by the chief forest ranger, Mr. Margach, amounted to 20,000,000 ft., which in addition to the 13,000,000 ft. estimated as being the quantity left over from the cut of 1907 and 1908, will make 33,000,000 ft., which the mill-owners will require to manufacture into lumber during this season.

As requested by you in your letter of instructions, I beg leave to say that \$14.91 per thousand feet, is the average price at which the lumber sold throughout this district, during the last year.

## GRAZING.

The area under lease for grazing purposes in the Calgary land district is approximately 410,000 acres, 166 leases being still in force.

In regard to this industry, I may say that the day of the large rancher is practically a thing of the past, and the man with the small band of cattle is taking his place. I would recommend, however, that the demands of the stockmen should receive every consideration, as this is no doubt a great stock country, and in my opinion it would be good policy to encourage stock growing as much as possible.

It is a well known fact among those who know anything about this country that there are waste places suitable only for ranching purposes.

It has been demonstrated that some settlers will endeavour to farm almost anywhere, but it is not always in their own interests that they should be allowed to establish themselves on land that is unfit for agricultural purposes.

Special encouragement should be given to those who are desirous of providing plenty of food and shelter for their cattle, and are willing to embark in the business of feeding for the market. Such concerns will buy large quantities of feed from the farmer, and in the event of a crop failure, or partial failure at any time, we will have something to fall back upon. At the present time, I may say that it has been the salvation of farmers who are far away from the railway to have cattle sent to them by large cattle buyers, to feed for the winter, or otherwise there would be absolutely no market for their grains.

Where a stockman has already established himself and embarked in the business of preparing cattle for the market he will necessarily require a considerable area of land for grazing, and to grow feed upon to enable him to successfully carry on his business, and I am of the opinion that he should be allowed to acquire sufficient land for that purpose at a reasonable price. At the same time the rancher should undertake on his part in acquiring the land that it is not for speculative purposes, and that he intends continuing the business in which he is engaged.

Your obedient servant,

J. R. SUTHERLAND,  
*Crown Timber Agent.*

SESSIONAL PAPER No. 25

SCHEDULE A.—STATEMENT of Receipts from Crown Timber Agency at Calgary for Fiscal Year ending March 31, 1909.

| Month.                         | Bonus under License. | Ground Rent under License. | Royalty Dues under License. | Permit Fees, Dues and Rental. | Seizures. | Grazing Lands Rentals. | Hay Permits, Fees and Dues. | Totals.   |
|--------------------------------|----------------------|----------------------------|-----------------------------|-------------------------------|-----------|------------------------|-----------------------------|-----------|
|                                | \$ cts.              | \$ cts.                    | \$ cts.                     | \$ cts.                       | \$ cts.   | \$ cts.                | \$ cts.                     | \$ cts.   |
| 1908.                          |                      |                            |                             |                               |           |                        |                             |           |
| April .....                    |                      | 313 01                     | 953 17                      | 62 21                         |           | 145 50                 | 428 50                      | 1,902 39  |
| May .....                      |                      | 689 40                     | 192 34                      | 216 03                        |           | 836 83                 | 154 00                      | 2,088 60  |
| June .....                     |                      | 119 82                     |                             | 10 82                         |           | 12 80                  | 164 05                      | 307 49    |
| July .....                     |                      | 64 28                      | 774 66                      | 67 52                         |           | 408 85                 | 275 40                      | 1,590 71  |
| August .....                   |                      | 17 60                      | 447 74                      | 191 29                        | 4 74      | 1,016 86               | 44 20                       | 1,722 45  |
| September .....                |                      |                            |                             | 329 28                        | 9 00      | 8 85                   | 10 50                       | 357 89    |
| October .....                  |                      |                            | 456 27                      | 120 13                        |           | 219 76                 |                             | 796 16    |
| November .....                 |                      | 68 16                      | 1,074 50                    | 74 87                         | 598 25    | 663 58                 | 7 50                        | 2,486 86  |
| December .....                 |                      |                            | 552 36                      | 549 12                        | 150 00    | 791 94                 | 8 00                        | 2,051 42  |
| 1909.                          |                      |                            |                             |                               |           |                        |                             |           |
| January .....                  |                      |                            | 825 55                      | 490 89                        |           | 61 27                  |                             | 1,377 71  |
| February .....                 |                      |                            | 35 13                       | 232 91                        | 200 00    | 344 07                 |                             | 892 11    |
| March .....                    |                      |                            | 301 55                      | 248 70                        |           | 237 22                 |                             | 807 47    |
| Totals .....                   |                      | 1,272 53                   | 5,673 27                    | 2,613 77                      | 961 99    | 4,767 53               | 1,092 15                    | 16,381 24 |
| Collected at head office ..... |                      | 7,492 10                   | 59 47                       | 183 00                        |           |                        |                             | 8,234 57  |
|                                |                      | 9,204 63                   | 5,732 74                    | 2,796 77                      |           |                        |                             | 24,615 81 |

NOTE.—Bonuses are collected at head office.





9-10 EDWARD VII., A. 1910

## SCHEDULE C.—SHOWING the Mills (including the Portable Mills) operating within the

| Mill Owner.              | Location of Mill. | Berth No. | Species of Timber Cut. | LUMBER.             |                     |            |
|--------------------------|-------------------|-----------|------------------------|---------------------|---------------------|------------|
|                          |                   |           |                        | Manu-<br>factured.  | Sold.               | On Hand.   |
|                          |                   |           |                        | Ft., B. M.          | Ft., B. M.          | Ft., B. M. |
| Thomas Quigley           | Cochrane          | 1307      | Spruce, fir, pine      | 249,000             | 262,000             |            |
| Wm. J. McIntyre          | Didsbury          | 1344      | "                      |                     | 16,000              |            |
| David Black              | On Berth          | 1326      | "                      | 103,675             | 550,000             |            |
| W. W. Channell           | "                 | 1304      | " and pine             |                     |                     |            |
| Joseph Fisher            | Millarville       | 1358      | "                      | 49,000              | 40,000              | 35,000     |
| J. R. Shell              | On Berth          | 1380      | " and pine             | 271,865             | 323,183             |            |
| Samuel J. Templeton      | Beaver Creek      | 1409      | " and fir              |                     |                     | 20,529     |
| Arthur G. Spooner        | On Berth          | 1406      | "                      | 213,000             | 78,000              | 189,000    |
| Great West Lumber Co.    | Red Deer          | 1472      | Cypress pine           |                     |                     |            |
| Charles Stubbs           | On Berth          | 1396      | Spruce and fir         | 41,800              | 108,280             | 39,582     |
| West Can. Collieries     | Lille             | 1432      | " and pine             |                     | 100,000             |            |
| Francis Du Rocher        | On Berth          | 1520      | "                      | 27,744              | 39,744              |            |
| Archibald Lake           | "                 | 1506      | " and fir              | 374,055             | 354,055             | 20,000     |
| W. H. Gibson             | "                 | 1521      | " and pine             | 1,801,516           | 1,489,516           | 312,000    |
| Lineham Lumber Co.       | High River        | 1428      | Pine                   | 2,196,412           | 1,127,684           | 1,068,728  |
| "                        | "                 | 1433      | "                      | 1,240,688           | 533,881             | 706,807    |
| Joseph Peters            | Cypress Hills     | 1553      | Spruce                 | 44,000              | 12,000              | 32,000     |
| P. W. Halvarson          | Blk. Diamond      | 1427      | "                      | 597,436             | 422,436             | 175,000    |
|                          |                   |           |                        | 7,210,191           | 5,456,779           | 2,598,646  |
| Inter. Coal and Coke Co. | Coleman           | 1529      | Pine and mining props. | Lin. Ft.<br>56,810  | Lin. Ft.<br>56,810  |            |
| E. G. Hazell             | Crowsnest         | 1510      | Dry cord wood          | Cords.<br>350       | Cords.<br>350       |            |
| Inter. Coal and Coke Co. | Coleman           | 36A       | Dry mining props       | Lin. Ft.<br>683,236 | Lin. Ft.<br>683,236 |            |



SESSIONAL PAPER No. 25

Calgary Agency under Government Permits, for the Fiscal Year ending March 31, 1909.

| LOG COUNT. |                    |               | Average per Log. | RAILWAY TIES. |        | Average Price of Lumber per M ft. | No. of Returns made. | Date of Last Return. | REMARKS.  |
|------------|--------------------|---------------|------------------|---------------|--------|-----------------------------------|----------------------|----------------------|---|
| Logs Cut.  | Logs Manufactured. | Logs on Hand. |                  | Manufactured. | Sold.  |                                   |                      |                      |   |
|            |                    |               | Ft.<br>B. M.     |               |        | \$ cts.                           |                      |                      |   |
|            | 3,350              |               | 74 32            |               |        | 13 00                             | 4                    | Mar. 31, '09         |   |
|            |                    |               |                  |               |        | 14 00                             | 1                    | June 30, '08         | Berth cancelled.  |
|            | 3,000              |               | 34 33            |               |        | 14 00                             | 1                    | Sept. 30, '08        | " "   |
|            |                    | 1,190         |                  |               |        |                                   | 3                    | Mar. 31, '09         |   |
|            | 965                |               | 50 77            |               |        | 12 50                             | 4                    | " 31, '09            |   |
|            | 6,176              |               | 44 00            |               |        |                                   | 3                    | Dec. 31, '08         | " "   |
| 2,600      | 4,500              | 2,900         | 47 50            |               |        | 12 25                             | 4                    | Mar. 31, '09         |   |
| 865        |                    | 5,281         |                  |               |        |                                   | 4                    | " 31, '09            | Permit for G. T. P.   |
| 662        | 500                | 662           | 83 60            |               |        | 10 00                             | 2                    | Dec. 31, '08         |   |
|            |                    |               |                  |               |        |                                   | 3                    | " 31, '08            | Products used in their mine.                                    |
| 448        | 503                |               | 55 15            |               |        | 10 00                             | 2                    | Sept. 30, '08        |   |
| 18,513     | 18,013             | 500           | 20 70            |               |        | 12 02                             | 4                    | Mar. 31, '09         |   |
| 27,547     | 25,567             | 1,980         | 70 40            |               |        | 11 00                             | 4                    | " 31, '09            |   |
| 137,359    | 75,216             | 62,143        | 29 20            | 68,675        | 68,675 | 13 93                             | 3                    | " 31, '09            | Permit for G. T. P.   |
| 47,414     | 47,810             |               | 25 90            | 23,832        | 23,832 | 13 82                             | 3                    | " 31, '09            | " "   |
| 12,370     | 12,370             |               | 48 21            |               |        | 14 00                             | 5                    | Mar. 31, '09         |   |
| 247,778    | 197,970            | 74,656        | 36 42            | 92,507        | 92,507 | 12 54 33                          | 51                   |                      |   |
|            |                    |               |                  |               |        |                                   |                      |                      | Used in mine.   |
|            |                    |               |                  |               |        |                                   |                      |                      | Used burning lime.  |
|            |                    |               |                  |               |        |                                   |                      |                      | Taken from timber less than 10 ins. in diameter, used in mines. |

J. R. SUTHERLAND,  
Crown Timber Agent.

9-10 EDWARD VII., A. 1910

SCHEDULE D.—GENERAL Office Return of the Crown Timber Agency, Calgary for Fiscal Year ending March 31, 1909.

| Particulars.  | Number, &c. | As compared with previous year, increase. | As compared with previous year, decrease. | Remarks.                  |
|---|-------------|---|---|---------------------------|
| Letters received.....                               | 34,740      |   | 61  | Including Dominion lands. |
| Letters written.....                                | 34,196      | 5,032                                     |   | " "                       |
| Permits subject to dues issued.....                 | 16          |   | 27  |                           |
| Free permits issued.....                            | 620         |   | 231                                       |                           |
| Seizures made.....                                  | 10          |   | 5   |                           |
| Mill returns received and verified.....             | 115         | 15  |   |                           |
| Mills operating under government license.....       | 16          |   | 1   |                           |
| Mills operating under government permits.....       | 20          | 8   |   |                           |
| Quantity of lumber manufactured, under license..... | 13,730,588  |   | 7,791,408                                 |                           |
| Quantity of lumber sold, under license.....         | 11,211,737  |   | 5,531,508                                 |                           |
| Quantity of lumber on hand, under license.....      | 11,012,964  | 2,647,049                                 |   |                           |
| Average price at which lumber sold....              | \$14.91     |   | \$7.38                                    |                           |
| Hay permits issued.....                             | 195         | 24  |   |                           |

J. R. SUTHERLAND,  
Crown Timber Agent.

SCHEDULE E.—STATEMENT showing the Quantity of Timber cut under Permit at the Calgary Agency.

| Month.         | Lin. ft., B. logs. | Feet B.M. Lumber. | Roof poles. | Fence rails. | Fence posts. | Dry wood. |
|----------------|--------------------|-------------------|-------------|--------------|--------------|-----------|
| 1908.          |                    |                   |             |              |              |           |
| April.....     | 21,950             | 352,372           | 13,955      | 73,575       | 15,840       | 1,093     |
| May.....       | 12,985             | 283,724           | 14,510      | 79,191       | 17,992       | 1,156     |
| June.....      | 17,800             | 101,327           | 12,030      | 58,128       | 13,865       | 880       |
| July.....      | 13,730             | 57,919            | 9,290       | 47,400       | 9,976        | 719       |
| August.....    | 3,000              | 97,284            | 4,656       | 23,800       | 5,198        | 376       |
| September..... | 9,028              | 99,150            | 5,413       | 29,290       | 6,672        | 431       |
| October.....   | 6,000              | 197,416           | 9,543       | 49,400       | 12,080       | 746       |
| November.....  | 21,739             | 323,397           | 16,001      | 86,820       | 20,541       | 1,335     |
| December.....  | 10,140             | 1,082,493         | 39,170      | 210,075      | 47,200       | 3,006     |
| 1909.          |                    |                   |             |              |              |           |
| January.....   | 33,285             | 725,993           | 36,002      | 204,487      | 42,719       | 2,999     |
| February.....  | 18,000             | 1,687,383         | 27,128      | 159,170      | 36,710       | 2,326     |
| March.....     | 14,750             | 433,652           | 19,760      | 103,365      | 22,850       | 1,549     |
| Total.....     | 182,409            | 5,442,620         | 207,458     | 1,124,701    | 251,643      | 16,616    |

J. R. SUTHERLAND,  
Crown Timber Agent.







9-10 EDWARD VII., A. 1910

## SCHEDULE C.—Showing the Mills (including the Portable Mills) operating within the

| Mill Owner.                                 | Location of Mill.                | Berth No.  | Species of<br>Timber Cut. | LUMBER.                   |                      |                      |
|---|----------------------------------|--|---------------------------|---------------------------|----------------------|----------------------|
|   |                                  |  |                           | Manufactured<br>Ft. B. M. | Sold<br>Ft. B. M.    | On Hand<br>Ft. B. M. |
| Isaac Gagnon.....                           | Athaabaska L'dg.,                | 1,298  | Spruce....                | 200,000                   | 140,000              | 126,000              |
| D. R. Fraser & Co., and<br>John Walter..... | Edmonton and<br>Strathcona ...   | 1,306  | .....                     | 662,979                   | 1,890,268            | 662,972              |
| Henry Meyer.....                            | Berth .....                      | 1,308  | .....                     | 238,913                   | 150,433              | 263,960              |
| J. A. L. McDougall.....                     | " .....                          | 1,309  | .....                     | .....                     | 13,620               | 56,380               |
| H. L. McInnis.....                          | Pickardville.....                | 1,329  | .....                     | 739,471                   | 156,637              | 532,834              |
| F. C. Papineau.....                         | Berth .....                      | 1,337  | .....                     | 42,700                    | 171,720              | 6,000                |
| A. D. McDiarmid.....                        | .....                            | 1,347  | .....                     | .....                     | .....                | 241,848              |
| R. A. McDonald.....                         | .....                            | 1,357  | .....                     | .....                     | .....                | 135,420              |
| J. E. Gibeault.....                         | .....                            | 1,381  | .....                     | 35,272                    | 64,214               | 25,635               |
| R. T. Telford.....                          | .....                            | 1,386  | .....                     | .....                     | 122,000              | 146,000              |
| White & Short.....                          | .....                            | 1,505  | .....                     | 230,000                   | 26,000               | 204,000              |
| E. J. Dowsett.....                          | .....                            | 1,515  | .....                     | .....                     | .....                | .....                |
| Amedee Roy.....                             | .....                            | 1,526  | .....                     | .....                     | .....                | 64,244               |
| Wm. Brunelle.....                           | Chicken Hill...                  | 1,571  | .....                     | 33,650                    | 1,500                | 32,150               |
| John Walter.....                            | Edmonton and<br>Strathcona ..... | Sp'l permit<br>Order in<br>Council.<br>10-7-'07,<br>do | .....                     | .....                     | .....                | .....                |
| Edmonton Lumber Co.....                     | Edmonton.....                    | .....  | .....                     | 3,449,466<br>339,048      | 1,461,013<br>257,658 | 2,243,274<br>81,390  |
| John Walter.....                            | Edmonton and<br>Strathcona ..... | S. L. No. 33   | .....                     | 5,971,499<br>485,737      | 4,455,063<br>747,776 | 4,822,107<br>.....   |
| Total.....                                  |                                  |  |                           | 6,457,236                 | 5,202,839            | 4,822,107            |

## SESSIONAL PAPER No. 25

Edmonton Agency, under Government Permits, for the Fiscal Year ending March 31, '09.

| LOG COUNT.   |                            |                  | Average per Log<br>Ft. B. M. | RAILWAY<br>TIES.   |        |          | Average Price of<br>Lumber per M. ft. | No. of Returns<br>made. | Date of Last<br>Return. | REMARKS.            |
|--------------|----------------------------|------------------|------------------------------|--------------------|--------|----------|---------------------------------------|-------------------------|-------------------------|---------------------|
| Logs<br>Cut. | Logs<br>Manufac-<br>tured. | Logs on<br>Hand. |                              | Manufac-<br>tured. | Sold.  | On hand. |                                       |                         |                         |                     |
| ...          | 3,000                      | 700              | 66.6                         | .....              | .....  | .....    | \$ 20.00                              | 4                       | Mar. 31, '69            |                     |
| .....        | 6,916                      | 10,990           | 95.45                        | .....              | .....  | .....    | 12.00                                 | 3                       | Dec. 31, '08            |                     |
| .....        | 2,590                      | .....            | 92.24                        | .....              | .....  | .....    | 10.00                                 | 4                       | Mar. 31, '09            |                     |
| .....        | .....                      | 1,300            | .....                        | .....              | .....  | .....    | 15.00                                 | 2                       | Sept. 30, '08           |                     |
| .....        | 14,498                     | .....            | 51                           | .....              | .....  | .....    | 15.00                                 | 4                       | Mar. 31, '09            |                     |
| 386          | 1,030                      | 50               | 41.47                        | .....              | .....  | .....    | 11.00                                 | 3                       | Dec. 31, '08            | LATH—               |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | Apr. 17, '08            | Sold.....9,000      |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | Apr. 30, '08            | On hand.....        |
| .....        | 592                        | 2,628            | 59.5                         | .....              | .....  | .....    | 12.90                                 | 3                       | Dec. 31, '08            |                     |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | 18.00                                 | 4                       | Mar. 31, '09            | SHINGLES—           |
| 4,200        | 4,600                      | .....            | 50                           | .....              | .....  | .....    | 16.00                                 | 4                       | Mar. 31, '09            | Manuf'd.....96,250  |
| 389          | 300                        | 89               | .....                        | .....              | .....  | .....    | .....                                 | 2                       | Dec. 31, '08            | Sold.....96,250     |
| .....        | .....                      | 40               | .....                        | .....              | .....  | .....    | .....                                 | .....                   | Dec. 31, '07            | On hand.....        |
| 3,925        | 775                        | 3,152            | 44.8                         | .....              | .....  | .....    | 15.00                                 | 1                       | Mar. 31, '09            |                     |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | SHINGLES—           |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | Manuf'd.....199,750 |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | Sold.....111,750    |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | On hand.....88,000  |
| .....        | 86,288                     | 96,687           | 39.19                        | 26,798             | 26,798 | .....    | 16.00                                 | 4                       | Mar. 31, '09            |                     |
| 7,434        | 6,585                      | 849              | 51.4                         | .....              | .....  | .....    | 12.00                                 | 3                       | Dec. 31, '08            |                     |
| 16,328       | 127,204                    | 116,485          | .....                        | 26,798             | 26,798 | .....    | .....                                 | .....                   | Lath.....               | 9,000               |
| 2,956        | 9,223                      | .....            | 51.5                         | .....              | .....  | .....    | .....                                 | .....                   | Shingles.....           | 296,000             |
| 19,284       | 136,427                    | 116,485          | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | 208,000             |
| .....        | .....                      | .....            | .....                        | .....              | .....  | .....    | .....                                 | .....                   | .....                   | 88,000              |

Certified correct.

K. W. MACKENZIE,  
Crown Timber Agent.

9-10 EDWARD VII., A. 1910

## SCHEDULE D.—GENERAL Office Return of the Crown Timber Agency, Edmonton, for Fiscal Year ending March 31, 1909.

| Particulars.                                   | Number, &c. | As compared with previous year, increase. | As compared with previous year, decrease. |
|--|-------------|---|---|
| Letters received                               |             |   |   |
| Letters written                                |             |   |   |
| Permits subject to dues issued                 | 366         | 272                                       |   |
| Free permits issued                            | 1,478       | 1,000                                     |   |
| Seizures made                                  | 57          | 25  |   |
| Mill returns received and verified             | 292         |   | 98  |
| Mills operating under government license       | 9           |   |   |
| " " government permits                         | 16          | 6   |   |
| Quantity of lumber manufactured, under license | 9,679,117   |   | 6,424,970                                 |
| " " sold, "                                    | 7,112,690   | 5,938,534                                 |   |
| " " on hand, "                                 | 8,304,652   | 714,609                                   |   |
| Average price at which lumber sold             | \$13.70     |   |   |
| Hay permits issued, Dominion lands             | 362         | 139                                       |   |
| " " school "                                   | 172         |   | 8   |

Correct correct.

K. W. MACKENZIE,  
Crown Timber Agent.

## No. 26.

## REPORT OF THE CROWN TIMBER AGENT AT PRINCE ALBERT.

DEPARTMENT OF THE INTERIOR,  
DOMINION LANDS AND CROWN TIMBER OFFICE,  
PRINCE ALBERT, SASKATCHEWAN, April 14, 1909.

The Commissioner of Dominion Lands,  
Ottawa, Ont.

SIR,—I have the honour to submit for your consideration the annual report of this office for the fiscal year ending March 31, 1909.

Attached hereto you will find the following detailed statements:—

Schedule 'A,' being a statement showing receipts from timber, grazing and hay on Dominion lands.

Schedule 'B,' being a statement showing saw-mills operating under license.

Schedule 'C,' being a statement showing saw-mills (including portable mills) operating under government permits.

Schedule 'D,' being a statement of the general office work performed.

These statements show a decided increase over the preceding year both in volume of work and revenue collected, the total receipts being \$38,229.53, as against \$28,333.74 for the previous twelve months.

The sales of lumber manufactured under license show an increase of 13,362,450 feet, while the average price per thousand feet shows \$17.54%, being a reduction of \$3.35% as compared with last year.

The average number of feet per log on licensed berths is shown as 58 $\frac{1}{2}$ , and on permit berths as 30 $\frac{3}{4}$ .









9-10 EDWARD VII., A. 1910

## SCHEDULE C.—SHOWING the Mills (including the Portable Mills) operating within ending

| Mill Owner.                 | Location of Mill. | Berth No. | Species of Timber Cut. | LUMBER.                        |                      |                         |
|-----------------------------|-------------------|-----------|------------------------|--------------------------------|----------------------|-------------------------|
|                             |                   |           |                        | Manu-<br>factured.<br>Ft. B.M. | Sold.<br>Ft.<br>B.M. | On hand.<br>Ft.<br>B.M. |
| Crowston, Wm.....           | 9-42-16 W 2 ..    | 853       | Spruce.....            | 114,606                        | 114,606              | .....                   |
| Garneau, Laurence.....      | 25-15-4 W 3 ..    | 1172      | " .....                | .....                          | .....                | .....                   |
| Johnston and Brostrom.....  | 15-50-27 W 2 ..   | 876       | " .....                | 8,000                          | .....                | 8,000                   |
| Carrot River Lumber Co..... | 3-48-13 W 2 ..    | 1544      | " .....                | .....                          | .....                | .....                   |
| Morrow, W. H.....           | 24-46-13 W 2 ..   | 757       | " .....                | 86,933                         | .....                | 86,938                  |
| Meier, John F.....          | 18-50-14 W 2 ..   | 1408      | " .....                | .....                          | .....                | .....                   |
| Sansfield and Adams.....    | Halcro.....       | 1507      | Spruce and poplar..... | .....                          | .....                | .....                   |
| Otte, Joseph.....           | 34-49-5 W 3 ..    | 1459      | " .....                | 188,416                        | 95,073               | 93,343                  |
| Ross Bros.....              | Turtle Lake ..    | 1556      | " .....                | .....                          | .....                | .....                   |
| Marcotte, Alcide.....       | 17-45-4 W 2 ..    | 1580      | " .....                | .....                          | .....                | .....                   |
| Hendrikson and Johnson..... | .....             | .....     | .....                  | .....                          | .....                | .....                   |
|                             |                   |           |                        | 397,960                        | 209,679              | 188,281                 |

## SESSIONAL PAPER No. 25

the Prince Albert Agency, under Government Permits, for the Fiscal Year  
March 31, 1909

| LOG COUNT. |                         |                  | Average per<br>Log, Ft. B.M. | RAILWAY TIES.           |       |             | Average price<br>of lumber per<br>M. feet. | No of returns<br>made. | Date of last<br>return. | Remarks.   |
|------------|-------------------------|------------------|------------------------------|-------------------------|-------|-------------|--|------------------------|-------------------------|------------|
| Logs Cut.  | Logs manu-<br>factured. | Logs on<br>hand. |                              | Manu-<br>fact-<br>ured. | Sold. | On<br>hand. |  |                        |                         |            |
| 8,097      | 5,097                   | 3,000            | 22                           | Nil.                    | Nil.  | Nil.        | 20 00                                      | 4                      | March 31, 1909..        |            |
| 8,500      |                         | 8,500            |                              |                         |       |             |  | 4                      | " " "                   |            |
| *800       |                         |                  |                              |                         |       |             |  |                        |                         |            |
| 2,300      | 296                     | 2,804            | 27                           | 8,673                   | 8,673 | Nil.        |  | 4                      | " " "                   |            |
| 4,283      |                         | 4,283            |                              |                         |       |             |  | 1                      | Dec. 31, '08 ..         |            |
| 1,738      | 1,738                   |                  |                              |                         |       |             |  | 1                      | March 31, 1909..        |            |
|            |                         |                  |                              |                         |       |             |  |                        |                         | No returns |
| 4,568      | 4,338                   | 230              | 43                           |                         |       |             | 14 25                                      | 2                      | Sept. 30, 1908..        | "          |
| 2,893      |                         | 2,893            |                              |                         |       |             |  | 1                      | Dec. 31, 1908..         | "          |
|            |                         |                  |                              |                         |       |             |  |                        |                         | "          |
|            |                         |                  |                              |                         |       |             |  |                        |                         | "          |
| 33,179     | 11,469                  | 21,710           | 30 $\frac{3}{4}$             | 8,673                   | 8,673 | Nil.        | 17 12 $\frac{1}{2}$                        | 17                     |                         |            |
| Less *800  |                         |                  |                              |                         |       |             |  |                        |                         |            |

\*Show amount on hand April 1, 1980.

Certified correct.

GEO. L. DEMPSTER,  
Crown Timber Agent.

9-10 EDWARD VII., A. 1910

SCHEDULE D.—GENERAL Office Return of the Crown Timber Agency, Prince Albert, for  
Fiscal Year ending March 31, 1909.

| Particulars.                                       | Number,<br>&c.        | As com-<br>pared with<br>previous<br>year.<br>Increase. | As com-<br>pared with<br>previous<br>year.<br>Decrease. |
|--|-----------------------|---|---|
| Letters received.....                              | 15,442                | 2,063   |   |
| Letters written.....                               | 13,981                | 3,113   |   |
| Permits subject to dues issued.....                | 370                   | 283   |   |
| Free permits issued.....                           | 987                   |   |   |
| Seizures made.....                                 | 92                    | 46  |   |
| Mill returns received and verified.....            | 78                    | 16  |   |
| Mills operating under government license.....      | 6                     |   |   |
| " " " permits.....                                 | 11                    | 5   |   |
| Quantity of lumber manufactured under license..... | 39,435,674            |   | 10,773,116  |
| " " sold under license.....                        | 48,734,960            | 13,362,450  |   |
| " " on hand under license.....                     | 20,670,864            |   | 9,299,286   |
| Average price at which lumber sold.....            | \$17 54 $\frac{3}{4}$ |   | \$3.35 $\frac{3}{4}$                                    |
| Hay permits issued.....                            | 176                   | 106   |   |

Certified Correct.

GEO. L. DEMPSTER,  
*Crown Timber Agent.*

No. 27.

REPORT OF THE CROWN TIMBER AGENT AT NEW WESTMINSTER.

DEPARTMENT OF THE INTERIOR.

DOMINION LANDS AND CROWN TIMBER OFFICE,

NEW WESTMINSTER, B.C., May 14, 1909.

The Commissioner of Dominion Lands,  
Ottawa, Ont.

SIR,—I have the honour to submit herewith my annual report covering the fiscal year ending the 31st of March last. In submitting this report I may say that it gives me pleasure to be able to state that the condition of the lumber business in this province has improved considerably during the past three months, and I consider that with careful management the business this year will be found very satisfactory indeed. The demand from the prairie provinces this spring is much in excess of last year, and as retail stocks on hand there are very much below the average it is expected that with the increase of population the demand will continue all through the summer months. Considerable railway extensions are also contemplated and these will add their quota to the demand.

Schedule 'A,' which is inclosed, shows the receipts of this office for the year, amounting to \$48,787.39, and the amount collected at head office on account of this agency, \$6,948.86. This is a considerable falling off from the previous year, when the receipts of this office were \$63,670.77, and is explained by the fact that during the latter part of last year the mills in the interior found themselves with large stocks of lumber on hand produced by high-priced labour and which it was impossible to dispose of even at the cost of production. Conditions are, however, improved, and the companies are now finding it much easier to meet their obligations.

## SESSIONAL PAPER No. 25

Schedule 'B,' which is inclosed, shows saw-mills operating in the Railway Belt under government licenses, also shows the names of licensees operating on Dominion lands and who have no saw-mills in connection therewith. This schedule shows that approximately 53,923,157 feet board measure of saw logs was cut during the year. Out of this amount and what was on hand from the previous year, 54,621,244 feet board measure was sold, leaving 28,718,487 feet board measure on hand. The amount shown on hand is considerably less than last year, but does not represent the actual lumber on hand at the different mills for the reason that a number of the larger companies have been placed in a position to make returns on the log scale at the end of each quarter, and while the logs are shown as sold this is not the case, as in many instances it is months afterwards before they are manufactured into lumber and placed in the yard to be finally disposed of. This system of returns, however, has been found to be very much more satisfactory than the old method of returns on the mill product.

Schedule 'C,' which is also inclosed, gives information relating to the number of letters received and written, permits and seizures made, mill returns received, &c., and will go to show that while the revenue of the office during the year under review has been less than for the previous year the general work of the agency has increased to a very great extent.

Your obedient servant,

JAMES LEAMY,

*Crown Timber Agent.*

9-10 EDWARD VII., A. 1910

## SCHEDULE A.—STATEMENT of Receipts from Crown Timber Agency at New Westminster for Fiscal Year ending March 31, 1909.

| Month.                      | Ground<br>Rent under<br>License. | Royalty<br>Dues under<br>License. | Permit Fees<br>Dues and<br>Rental. | Seizures. | Totals.   |
|-----------------------------|----------------------------------|-----------------------------------|------------------------------------|-----------|-----------|
| 1908.                       | \$ cts.                          | \$ cts.                           | \$ cts.                            | \$ cts.   | \$ cts.   |
| April .....                 | 7,729 88                         | 1,023 87                          | 162 75                             | .....     | 8,916 50  |
| May .....                   | 2,014 88                         | 1,681 21                          | 434 97                             | 406 22    | 4,537 28  |
| June .....                  | 5,636 33                         | 293 68                            | 81 32                              | 610 40    | 6,621 73  |
| July .....                  | 85 45                            | 2,591 48                          | 124 50                             | 115 14    | 2,918 57  |
| August .....                | 14 83                            | 509 13                            | 126 00                             | 642 48    | 1,292 44  |
| September .....             | .....                            | 3,021 14                          | 225 75                             | 49 50     | 3,296 39  |
| October .....               | .....                            | 3,993 14                          | 71 70                              | 21 75     | 4,086 59  |
| November .....              | .....                            | 3,257 76                          | 200 75                             | 45 00     | 3,503 51  |
| December .....              | 59 52                            | 3,080 60                          | 397 55                             | 9 00      | 3,546 67  |
| 1909.                       |                                  |                                   |                                    |           |           |
| January .....               | .....                            | 3,911 86                          | 572 50                             | 186 78    | 4,671 14  |
| February .....              | .....                            | 841 30                            | 458 98                             | 19 65     | 1,319 93  |
| March .....                 | 813 69                           | 2,665 80                          | 241 50                             | 357 45    | 4,078 64  |
| Totals .....                | 16,354 78                        | 26,870 97                         | 3,098 27                           | 2,463 37  | 48,787 39 |
| Collected at Head Office... | 6,948 86                         | .....                             | .....                              | .....     | 6,948 86  |
|                             |                                  |                                   |                                    |           | 55,736 25 |





9-10 EDWARD VII., A. 1910

SCHEDULE C.—GENERAL Office Return of the Crown Timber Agency, New Westminster, B.C., for Fiscal Year ending March 31, 1909.

| Particulars.   | Number, &c. | As compared with previous year. Increase. | As compared with previous year. Decrease. |
|--|-------------|---|---|
| Letters received .....                               | 3,867       | 1,682                                     |   |
| Letters written .....                                | 4,850       | 1,143                                     |   |
| Permits subject to dues issued .....                 | 72          | 30  |   |
| Free permits issued .....                            | 10          | 9   |   |
| Seizures made .....                                  | 18          | 6   |   |
| Mill returns received and verified .....             | 1,465       |   |   |
| Mills operating under Government license .....       | 16          |   |   |
| " " " Government permits .....                       | Nil         |   |   |
| Quantity of lumber manufactured, under license ..... | 53,923,157  |   | 20,168,523                                |
| " " sold, " " .....                                  | 54,621,244  | 3,479,851                                 |   |
| " " on hand, " " .....                               | 28,718,487  |   | 2,024,778                                 |
| Average price at which lumber sold .....             | \$14 20     |   |   |
| Hay permits issued .....                             | Nil         |   |   |

## No. 28.

## REPORT OF THE INSPECTOR OF RANCHES.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS AND CROWN TIMBER OFFICE,

CALGARY, ALBERTA, April 13, 1909.

The Commissioner of Dominion Lands,

Ottawa, Ont.

SIR.—I have the honour to submit herewith my report of the transactions of the office of the Inspector of Ranches for the fiscal year ending March 31, 1909.

During the year 1,740 inspections have been made and in the discharge of these duties 11,692 miles have been travelled by rail and 5,796 miles were covered by wagon. This is the mileage of Mr. Robertson and myself.

In comparing the number of inspections for the past year with the year previous it will be observed that the number is not as great, but this is due to the following reasons: During the months of April, May and June Mr. Robertson, of this office, was engaged in seed grain distribution, and I myself was engaged in the same work for April and a good part of May. When the pre-emption rush in the month of September was on, Mr. Robertson spent a greater part of the month giving them assistance in the land office here. Then during the months of December, January and February when there was no homestead inspector, Mr. Robertson was acting inspector.

Inclosed for your information is a comparative statement by years of stock shipped and handled from the ranching districts almost entirely. It will be noticed that the stock industry is on the increase and that a considerable advance has been made since the hard winter of 1906-7, when the loss to stock was extremely heavy. It will also be observed that the value of stock for this past year runs into the millions.

Cattle and all stock have wintered well on the range and up to this date there have been no losses because of bad weather conditions. However, during the month of October last the sheep men in the Walsh and Maple Creek districts experienced considerable loss because of the heavy fall of wet snow, for which they were unprepared, as their flocks were on the summer ranges away from the shelter provided at headquarters.

Your obedient servant,

ALBERT HELMER,

*Inspector of Ranches.*

SESSIONAL PAPER No. 25

STATEMENT showing Stock Shipments.

MAIN LINE.—MORLEY TO MOOSEJAW.

|                     |        |
|---------------------|--------|
| Export cattle ..... | 32,890 |
| Other cattle.....   | 13,750 |
| Horses .....        | 9,183  |
| Sheep.....          | 29,278 |

MACLEOD BRANCH.

|                    |       |
|--------------------|-------|
| Export cattle..... | 4,763 |
| Other cattle.....  | 4,111 |
| Horses.....        | 1,108 |
| Sheep.....         | 387   |

CROWSNEST.—DUNMORE TO PINCHER. ALBERTA RAILWAY AND IRRIGATION Co.

|                    |        |
|--------------------|--------|
| Export cattle..... | 9,471  |
| Other cattle.....  | 11,465 |
| Horses .....       | 2,001  |
| Sheep.....         | 8,665  |

EDMONTON BRANCH.

|                    |       |
|--------------------|-------|
| Export cattle..... | 1,166 |
| Other cattle.....  | 1,580 |
| Horses.....        | 158   |
| Sheep.....         | 285   |

TOTAL FOR 1908.

|                    |        |
|--------------------|--------|
| Export cattle..... | 48,290 |
| Other cattle.....  | 30,516 |
| Horses.....        | 12,450 |
| Sheep.....         | 38,665 |

CATTLE FOR YEAR 1908.

|                   |        |
|-------------------|--------|
| Total export..... | 61,810 |
| To Winnipeg.....  | 17,370 |
| To Coast.....     | 9,384  |
| To Butchers.....  | 10,428 |
| Total.....        | 98,992 |

COMPARATIVE STATEMENT FOR 1905, 1906, 1907 AND 1908.

1905.

|                    |         |               |       |
|--------------------|---------|---------------|-------|
| Horses.....        | 12,882; | Carloads..... | 644   |
| Cattle.....        | 84,405; | ".....        | 4,636 |
| Sheep.....         | 40,810; | ".....        | 204   |
| Export cattle..... | 49,991  | ".....        | 2,940 |

1906.

|                    |          |               |       |
|--------------------|----------|---------------|-------|
| Horses.....        | 19,549;  | Carloads..... | 977   |
| Cattle.....        | 114,651; | ".....        | 6,370 |
| Sheep.....         | 57,024;  | ".....        | 285   |
| Export cattle..... | 74,733;  | ".....        | 4,383 |

1907.

|                    |         |               |       |
|--------------------|---------|---------------|-------|
| Horses.....        | 11,382; | Carloads..... | 566   |
| Cattle.....        | 80,043; | ".....        | 4,447 |
| Sheep.....         | 28,573; | ".....        | 122   |
| Export cattle..... | 42,960; | ".....        | 2,527 |

1908.

|                    |         |               |       |
|--------------------|---------|---------------|-------|
| Horses.....        | 13,636; | Carloads..... | 680   |
| Cattle.....        | 98,992; | ".....        | 5,748 |
| Sheep.....         | 40,753; | ".....        | 650   |
| Export cattle..... | 61,810; | ".....        | 3,628 |

1907.

Canadian cattle to Chicago:—  
Via C. P. R. 249 cars,  
Via G. N. R. 190 cars.

1908.

Canadian cattle to Chicago:—  
Via C. P. R. 154 cars,  
Via G. N. R. 61 cars.

|                           |                |    |          |       |
|---------------------------|----------------|----|----------|-------|
| 13,636 horses represent   | \$1,636,320 00 | at | \$120 00 | each. |
| 37,182 cattle (butcher's) | \$1,102,916 00 | at | \$ 38 00 | each. |
| 40,753 sheep              | \$ 244,518 00  | at | \$ 6 00  | each. |
| 61,810 export cattle      | \$3,090,500 00 | at | \$ 50 00 | each. |

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SUMMARY of Work performed by A. Helmer, Inspector of Ranches, and Stanley M. Robertson, Assistant to Inspector of Ranches, from April 1, 1908, to March 31, 1909.

| Land inspections made .....                                | April.      | May.        | June.            | July. | Aug. | Sept. | Oct.            | Nov. | Dec. | Jan. | Feb.                 | Mar. |
|--|-------------|-------------|------------------|-------|------|-------|-----------------|------|------|------|----------------------|------|
| <i>Albert Helmer, Inspector of Ranches.</i>                | Seed grain. | 188         | 83               | 503   | 72   | 33    | Forest reserve. | 165  | 12   | 24   | 3                    | 200  |
| Miles driven.....  |             | 485         | 215              | 327   | 574  | 315   | 221             | 460  | 195  | 173  | 200                  | 304  |
| Miles by rail.....   |             | 2,022       | 835              | 598   | 740  | 672   | 300             | 998  | 866  | 212  | 300                  | 747  |
| <i>Stanley M. Robertson asst. to Inspector of Ranches.</i> | Seed grain. | Seed grain. | Seed grain part. | 63    | 74   | 173   | 71              | 130  | 9    | 28   | nil. With Hmsd Insp. | 69   |
| Miles driven.....  |             |             | 25               | 373   | 240  | 415   | 101             | 327  | 155  | 300  | nil.                 | 391  |
| Miles by rail.....   |             |             | 100              | 212   | 362  | 882   | 384             | 400  | 308  | 58   | nil.                 | 696  |

## No. 29.

## REPORT OF THE ACCOUNTANT.

DEPARTMENT OF THE INTERIOR,

ACCOUNTS BRANCH,

OTTAWA, June 10, 1909.

W. W. Cory, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit herewith statements of revenue collected from various sources during the fiscal year ended March 31, 1909, as follows:—

|   |                       |
|---|-----------------------|
| A. Dominion lands, including Yukon Territory..... | \$2,277,678 09        |
| B. Ordnance lands.....                            | 205,749 96            |
| C. School lands.....                              | 687,422 74            |
| D. Registration fees.....                         | 1,352 13              |
| E. Fines and forfeitures, N.W.T.....              | 241 00                |
| F. Fines under Immigration Act.....               | 40 00                 |
| G. Casual revenue.....                            | 26,224 29             |
| H. Seed grain repayments.....                     | 53,590 86             |
|   | <u>\$3,252,299 07</u> |

A statement of revenue on account of Dominion lands (Marked I.) shows the receipts monthly, classified under subheads; statement (Marked J) shows a comparison between the receipts on account of Dominion lands for the fiscal year ended March 31, 1909, as compared with the revenue of the previous twelve months.

I would draw attention to the total gross receipts on account of Dominion lands, which are the largest in the history of the department. I might also point out that the gross receipts from all sources for the fiscal year 1908-9 amount to \$3,252,299.07, or almost as much as was received during the ten years from 1886-87 to 1895-96, inclusive.

Your obedient servant,

CHAS. H. BEDDOE,  
Superintending Accountant.

## SESSIONAL PAPER No. 25

## A.—DOMINION Lands Revenue (cash and scrip) for the fiscal year ended March 31, 1909.

| Agencies.                               | Cash.        | Scrip.    | Total Cash<br>and<br>Scrip. |
|---|--------------|-----------|-----------------------------|
|   | \$ cts.      | \$ cts.   | \$ cts.                     |
| YUKON TERRITORY.                        |              |           |                             |
| Sales of lands .....                    | 7,495 21     | 480 00    | 7,975 21                    |
| Rentals of lands .....                  | 9,827 86     |           | 9,827 86                    |
| Map sales, office fees, &c. ....        | 41 00        |           | 41 00                       |
| Timber dues .....                       | 26,482 64    |           | 26,482 64                   |
| Hay permits .....                       | 140 50       |           | 140 50                      |
| Coal lands .....                        | 371 73       |           | 371 73                      |
| Mining fees .....                       | 88,838 50    |           | 88,838 50                   |
| Export tax on gold .....                | 81,585 07    |           | 81,585 07                   |
| Free certificates for export of gold .. | 166 00       |           | 166 00                      |
| Hydraulic leases .....                  | 4,488 81     |           | 4,488 81                    |
| Dredging leases .....                   | 10,272 07    |           | 10,272 07                   |
| Homestead fees .....                    | 80 00        |           | 80 00                       |
| Improvements .....                      | 135 00       |           | 135 00                      |
| Rent of water power .....               | 250 00       |           | 250 00                      |
| Suspense account .....                  | 2,350 85     |           | 2,350 85                    |
| Refunds of refunds .....                | 36 00        |           | 36 00                       |
|   | 282,561 24   | 480 00    | 233,041 24                  |
| DOMINION LANDS AGENCIES.                |              |           |                             |
| Battleford .....                        | 96,793 72    | 660 00    | 97,453 72                   |
| Brandon .....                           | 23,876 14    | 2,249 43  | 26,125 57                   |
| Calgary .....                           | 139,199 00   | 2,800 00  | 141,999 00                  |
| Dauphin .....                           | 25,664 08    |           | 25,664 08                   |
| Edmonton .....                          | 111,074 70   |           | 111,074 70                  |
| Estevan .....                           | 38,508 26    | 424 60    | 38,932 86                   |
| Humboldt .....                          | 41,738 44    | 295 74    | 42,034 18                   |
| Kamloops .....                          | 10,109 60    | 1,554 89  | 11,664 49                   |
| Lethbridge .....                        | 598,740 75   | 80 00     | 598,820 75                  |
| Moosejaw .....                          | 242,037 22   | 6,794 25  | 248,831 47                  |
| New Westminster .....                   | 2,742 43     | 80 00     | 2,822 43                    |
| Prince Albert .....                     | 34,526 55    | 880 00    | 35,406 55                   |
| Red Deer .....                          | 42,873 88    |           | 42,873 88                   |
| Regina .....                            | 76,882 25    |           | 76,882 25                   |
| Winnipeg .....                          | 30,754 97    | 3,837 36  | 34,592 33                   |
| Yorkton .....                           | 40,175 07    |           | 40,175 07                   |
|   | 1,555,697 96 | 19,657 27 | 1,575,354 23                |
| CROWN TIMBER AGENCIES.                  |              |           |                             |
| Battleford .....                        | 364 45       |           | 364 45                      |
| Brandon .....                           | 480 60       |           | 480 60                      |
| Calgary .....                           | 18,756 13    |           | 18,756 13                   |
| Dauphin .....                           | 9,284 69     |           | 9,284 69                    |
| Edmonton .....                          | 21,437 31    |           | 21,437 31                   |
| Estevan .....                           | 105 50       |           | 105 50                      |
| Humboldt .....                          | 238 00       |           | 238 00                      |
| Lethbridge .....                        | 247 90       |           | 247 90                      |
| Moosejaw .....                          | 209 72       |           | 209 72                      |
| New Westminster .....                   | 55,736 25    |           | 55,736 25                   |
| Prince Albert .....                     | 42,799 59    |           | 42,799 59                   |
| Red Deer .....                          | 375 51       |           | 375 51                      |
| Regina .....                            | 87 25        |           | 87 25                       |
| Winnipeg .....                          | 92,842 28    |           | 92,842 28                   |
| Yorkton .....                           | 389 70       |           | 389 70                      |
|   | 243,354 88   |           | 243,354 88                  |
| Carried forward .....                   | 2,031,614 08 | 20,136 27 | 2,051,750 35                |

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## A.—DOMINION Lands Revenue (cash and scrip) for the fiscal year ended March 31, 1909.—Continued.

| Agencies.   | Cash.     |      | Scrip. |      | Total Cash and Scrip. |      |
|---|-----------|------|--------|------|-----------------------|------|
|   | §         | cts. | §      | cts. | §                     | cts. |
| Brought forward . . . . .                         | 2,031,614 | 08   | 20,136 | 27   | 2,051,750             | 35   |
| MISCELLANEOUS.                                    |           |      |        |      |                       |      |
| Rocky Mountains Park . . . . .                    | 31,321    | 20   |        |      | 31,321                | 20   |
| Survey fees . . . . .                             | 42,388    | 31   |        |      | 42,388                | 31   |
| Irrigation fees . . . . .                         | 367       | 00   |        |      | 367                   | 00   |
| Patent fees . . . . .                             | 991       | 50   |        |      | 991                   | 50   |
| Map sales, office fees, &c. . . . .               | 5,352     | 20   |        |      | 5,352                 | 20   |
| Fees <i>re</i> Board of Examiners, D.L.S. . . . . | 1,046     | 00   |        |      | 1,040                 | 00   |
| Homestead fees . . . . .                          | 20        | 00   |        |      | 20                    | 00   |
| Sales of lands . . . . .                          | 224       | 62   |        |      | 224                   | 62   |
| Rentals of lands . . . . .                        | 10        | 00   |        |      | 10                    | 00   |
| Mining fees . . . . .                             | 3,799     | 10   |        |      | 3,799                 | 10   |
| Grazing lands . . . . .                           | 53,312    | 79   | 3,257  | 84   | 56,570                | 63   |
| Hay permits . . . . .                             | 5,781     | 30   |        |      | 5,781                 | 30   |
| Coal lands . . . . .                              | 55,164    | 16   |        |      | 55,164                | 16   |
| Dredging leases . . . . .                         | 916       | 27   |        |      | 916                   | 27   |
| Stone quarries . . . . .                          | 906       | 38   |        |      | 906                   | 38   |
| Rent of water power . . . . .                     | 292       | 28   |        |      | 292                   | 28   |
| Suspense account . . . . .                        | 1,982     | 31   |        |      | 1,982                 | 31   |
| Refunds of refunds . . . . .                      | 18,069    | 26   |        |      | 18,069                | 26   |
| Miscellaneous . . . . .                           | 731       | 22   |        |      | 731                   | 22   |
|   | 222,669   | 00   | 3,257  | 84   | 225,927               | 74   |
|   | 2,254,283 | 98   | 23,394 | 11   | 2,277,678             | 09   |
| Refunds . . . . .                                 | 101,029   | 37   | 1,434  | 41   | 102,463               | 78   |
|   | 2,153,254 | 61   | 21,959 | 70   | 2,175,214             | 31   |

CHAS. H. BEDDOE,  
*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## B.—STATEMENT of Ordnance Lands Revenue for the Fiscal Year ended March 31, 1909.

|                     |              |
|---------------------|--------------|
| 1908—               |              |
| April . . . . .     | \$ 280 50    |
| May . . . . .       | 713 90       |
| June . . . . .      | 726 75       |
| July . . . . .      | 960 41       |
| August . . . . .    | 946 60       |
| September . . . . . | 402 45       |
| October . . . . .   | 478 72       |
| November . . . . .  | 130 00       |
| December . . . . .  | 249 88       |
| 1909—               |              |
| January . . . . .   | 409 85       |
| February . . . . .  | 200,202 70   |
| March . . . . .     | 248 20       |
| Total . . . . .     | \$205,749 96 |

CHAS. H. BEDDOE,  
*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 19, 1909.

## SESSIONAL PAPER No. 25

## C.—STATEMENT of Receipts on Account of School Lands for the Fiscal Year ended March 31, 1909.

| Month.  | Manitoba<br>School<br>Lands. | Saskatche-<br>wan School<br>Lands. | Alberta<br>School<br>Lands. | Total.     |
|---|------------------------------|------------------------------------|-----------------------------|------------|
| 1908.   | \$ cts.                      | \$ cts.                            | \$ cts.                     | \$ cts.    |
| April.....  | 5,007 97                     | 12,915 78                          | 4,170 34                    | 22,094 09  |
| May.....  | 9,025 47                     | 5,657 40                           | 2,488 31                    | 17,171 18  |
| June.....   | 30,590 44                    | 7,595 43                           | 3,882 58                    | 42,068 45  |
| July.....   | 20,356 92                    | 4,007 82                           | 5,187 47                    | 29,552 21  |
| August.....   | 4,008 29                     | 3,803 85                           | 5,062 82                    | 12,874 96  |
| September.....  | 2,522 26                     | 2,239 70                           | 3,577 04                    | 8,339 00   |
| October.....  | 43,667 04                    | 21,778 29                          | 14,053 59                   | 79,498 92  |
| November.....   | 131,517 80                   | 50,326 39                          | 54,523 57                   | 236,367 76 |
| December.....   | 62,516 09                    | 25,062 57                          | 23,999 82                   | 111,578 48 |
| 1909.   |                              |                                    |                             |            |
| January.....  | 28,250 44                    | 15,161 07                          | 12,429 97                   | 55,841 48  |
| February.....   | 12,574 01                    | 10,632 90                          | 8,871 57                    | 31,478 48  |
| March.....  | 16,057 36                    | 14,405 76                          | 10,094 23                   | 40,557 35  |
|   | 366,094 09                   | 172,986 96                         | 148,341 31                  | 687,422 36 |
| Add refund cheque No. 272, account sales (princ.)<br>returned by Canadian Northern Railway not<br>used..... | 38                           |                                    |                             | 38         |
|   | 366,094 47                   | 172,986 96                         | 148,341 31                  | 687,422 74 |

CHAS. H. BEDDOE,

*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## D.—STATEMENT of Registration Fees in the Yukon Territory for the Fiscal Year ended March 31, 1909.

| Month.         | District.            | Registrar.         | Amount.  |
|----------------|----------------------|--------------------|----------|
| 1908.          |                      |                    | \$ cts.  |
| April.....     | Yukon Territory..... | Nap Laliberte..... | 136 28   |
| May.....       | ".....               | ".....             | 62 75    |
| June.....      | ".....               | ".....             | 89 50    |
| July.....      | ".....               | ".....             | 106 45   |
| August.....    | ".....               | ".....             | 132 10   |
| September..... | ".....               | ".....             | 180 90   |
| October.....   | ".....               | ".....             | 138 90   |
| November.....  | ".....               | ".....             | 200 50   |
| December.....  | ".....               | ".....             | 113 10   |
| 1909.          |                      |                    |          |
| January.....   | ".....               | ".....             | 71 10    |
| February.....  | ".....               | ".....             | 32 25    |
| March.....     | ".....               | ".....             | 88 30    |
|                |                      |                    | 1,352 13 |

CHAS. H. BEDDOE,

*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.  
25—i—8½

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## E.—STATEMENT of Fines and Forfeitures in the Northwest Territories for the Fiscal Year ended March 31, 1909.

| Month.     | From whom received.                                     | Amount. |
|------------|---|---------|
| 1908.      |   | \$ cts. |
| August.    | David Harris.   | 10 00   |
| September. | Henry Hunter.   | 25 00   |
| October.   | J. Whitehead, J. Pedersen, A. L. South, H. Benbow.      | 81 00   |
| 1909.      |   |         |
| January.   | Hudson's Bay Co., R. Massey, Thos. Wallace, W. Connell. | 100 00  |
| February.  | Horace Halcrow.   | 25 00   |
|            |   | 241 00  |

CHAS. H. BEDDOE,  
Superintending Accountant.

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## F.—STATEMENT of Fines collected under the Immigration Act for the Fiscal Year ended March 31, 1909.

| Month. | From whom received.        | Amount. |
|--------|----------------------------|---------|
| 1909.  |                            | \$ cts. |
| March. | Wm. Roberts, Thos. Piking. | 40 00   |

CHAS. H. BEDDOE,  
Superintending Accountant.

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## G.—STATEMENT of Casual Revenue for the Fiscal Year ended March 31, 1909.

| Name.                                      | Particulars.                                     | Amount. |
|--|--|---------|
|  |  | \$ cts. |
| J. W. Greenway.                            | Refund acct. travelling expenses.                | 158 30  |
| J. M. Bender.                              | " salary cheque for June, '06                    | 25 00   |
| H. N. Topley.                              | " travelling expenses.                           | 1 00    |
| D. D. Penner.                              | " redemption of lien.                            | 19 00   |
| B. Neville.                                | Proceeds of sale of tents                        | 80 00   |
| R. G. Wilkinson.                           | " "  | 10 00   |
| H. H. Rowatt.                              | Refund acct. travelling expenses.                | 228 05  |
| L. P. O. Noel.                             | " contingencies, January, 1908                   | 5 36    |
| L. P. O. Noel.                             | " Mrs. Noel's railway fare                       | 31 45   |
| E. O'Kelly.                                | " expenses                                       | 4 42    |
| F. A. McDiarmid.                           | " survey of 1907.                                | 4 25    |
| D. H. Nelles.                              | " "  | 50      |
| J. B. Challies.                            | " travelling expenses.                           | 4 80    |
| S. Maher.                                  | " "  | 100 94  |
| H. H. Rowatt.                              | " "  | 6 25    |
| Jas. Foster, per Immigration Commissioner. | " immigration cheque No. 10519 of Nov. 15, 1907. | 9 00    |
| W. W. Cory.                                | " travelling expenses                            | 93 10   |
| W. C. Jaques.                              | " survey of 1907.                                | 18 00   |
| Albert McLeod.                             | " salary for March, 1908, paid twice.            | 100 00  |
| H. Douglas.                                | " over-payment to J. H. Ashdown in March, 1908.  | 30      |



## SESSIONAL PAPER No. 25

G.—STATEMENT of Casual Revenue for the Fiscal Year ended March 31, 1909—*Con.*

| Name.  | Particulars.  | Amount.   |
|--|---|-----------|
| O. A. Miquelon, per Immigration Commissioner         | Proceeds of sale of tents   | \$ 380 00 |
| J. D. Page   | Sale of horse used at Detention Hospital, Quebec  | 100 00    |
| J. T. Lithgow  | Refund acct. travelling expenses  | 102 00    |
| F. H. Gosselin                                       | " "   | 96 00     |
| J. R. Sutherland                                     | " overpayment acct. C. Sharkaye's salary for March, 1908                                | 7 00      |
| M. J. Cullen   | " travelling expenses   | 109 80    |
| J. B. McNamee, per Immigration Commissioner          | " double payment re burials   | 12 00     |
| J. R. Sutherland, Immigration Commissioner, Winnipeg | " overpayment on postage March, 1908  | 20        |
| C. H. Beddoe   | Proceeds of sale of furniture of Immigration Hall at East Selkirk                       | 425 00    |
| J. J. McArthur                                       | Refund acct. travelling expenses  | 50 70     |
| A. J. Brabazon                                       | " survey of 1907  | 4 05      |
| Geo. White-Fraser                                    | " "   | 9 75      |
| R. D. Foley  | " "   | 2 50      |
| F. S. Neill, per Comptroller Dawson                  | " contingencies of October, 1907  | 13 70     |
| Thos. Fletcher, per H. Douglas                       | Amount paid for canoe Crown Timber Office, Dawson                                       | 15 00     |
| Jan. Siatocks, per Immigration Commissioner          | Refund acct. plough bolts in October, 1907  | 1 35      |
| N. Demazenski, per Immigration Commissioner          | " redemption of lien  | 17 50     |
| Robt. Arnold, per Immigration Commissioner           | " "   | 11 18     |
| Joseph Reichert, per Immigration Commissioner        | " overpayment on oats   | 22 50     |
| N. Peudzilo, per Immigration Commissioner            | " redemption of lien  | 14 10     |
| I. S. Doze   | " "   | 12 55     |
| N. Morak, per Immigration Commissioner               | Sale of horse   | 199 50    |
| J. W. Robertson                                      | Refund acct. redemption of lien   | 11 50     |
| J. D. Craig  | " salary for March, 1908, paid twice  | 100 00    |
| W. F. Ratz   | " Alaska boundary survey of 1906-07   | 172 22    |
| W. F. Ratz   | " " "   | 106 60    |
| J. D. Craig  | " " "   | 25        |
| Dominion Express Co., per High Commissioner, London  | " " "   | 15 50     |
| C. W. Speers   | " general average <i>S.S. Bavarian</i> , Nov. 5, 1905                                   | 2 78      |
| C. A. Bigger   | " duplicate charge in contingent acct. of Nov. 1907                                     | 9 80      |
| Jas. White   | " amounts paid to D. McLean (\$30.00) and H. B. Kihl (\$63.00) re Geodetic Survey, 1907 | 93 00     |
| Johan Reichert, per Immigration Commissioner         | " immigration expenses, 1907  | 10 00     |
| Geo. J. Johnston                                     | " redemption of lien  | 4 50      |
| H. Charlebois  | " immigration expenses 1907   | 10 00     |
| Comptroller of Yukon Territory                       | " " "   | 10 00     |
| W. A. Fuller, per Immigration Commissioner           | Unclaimed estates in Yukon  | 6,084 66  |
| W. F. Moore, per Immigration Commissioner            | Forfeiture of Immigration Cheque No. 9514 acct. stolen supplies                         | 67 50     |
| New Westminster Insane Asylum                        | Refund of Immigration Cheque No. 9165, being duplicate payment                          | 10 00     |
| N.W. Mounted Police "B" Division                     | Refund of amount received for maintenance of Robert Flett, December, 1907, Jan. 1909    | 77 50     |
| Geo. A. Johnston                                     | Refund of amount expended re transportation of Robert Flett in 1906-07                  | 1,385 17  |
| H. H. Gordon, per High Commissioner                  | Refund acct. immigration expenses in 1907   | 10 00     |
| Geo. A. Johnston                                     | " British Bonuses, February, 1908   | 14 60     |
| H. Charlebois  | " immigration expenses, 1907  | 10 00     |
| Immigration Commissioner, Winnipeg                   | " " "   | 10 00     |
| Jas. McDiarmid                                       | Proceeds of sale of loads of straw  | 10 00     |
| J. C. Wilson Co.                                     | Sale of old horse   | 25 00     |
| C. A. French   | Discount on bill for envelopes re immigration   | 1 46      |
| G. C. Rainboth                                       | Refund acct. geographical survey of 1908  | 6 58      |
|  | " boundary survey of 1906   | 85 25     |
|  |   | 10,835 97 |

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G.—STATEMENT of Casual Revenue for the Fiscal Year ended March 31, 1909—*Con.*

| Name.   | Particulars.       | Amount.         |
|---|--------------------|-----------------|
| <i>Casual Revenue, Northwest Territories.</i> |                    |                 |
| A. Larose.....                                | Liquor permit..... | \$ cts.<br>2 00 |
| Rev. F. Sevier.....                           | ".....             | 1 00            |
| Hudson's Bay Co.....                          | ".....             | 50 35           |
| ".....  | ".....             | 4 00            |
| ".....  | ".....             | 3 00            |
| Alex. Gardner.....                            | ".....             | 2 00            |
| H. Winterton.....                             | ".....             | 2 00            |
| L. L. Andrews.....                            | ".....             | 2 00            |
| R. D. Rough.....                              | ".....             | 2 00            |
| Wm. Campbell.....                             | ".....             | 2 00            |
| Hudson's Bay Co.....                          | ".....             | 3 00            |
| ".....  | ".....             | 3 00            |
| Rev. C. G. Fox.....                           | ".....             | 2 00            |
| Hudson's Bay Co.....                          | ".....             | 4 00            |
| E. Carter.....                                | ".....             | 2 00            |
| O. Lacroix.....                               | ".....             | 4 00            |
| Hudson's Bay Co.....                          | ".....             | 49 00           |
| ".....  | ".....             | 25 50           |
| C. Wood.....                                  | ".....             | 2 00            |
| Wm. Cobban.....                               | ".....             | 2 00            |
| J. F. Drummond.....                           | ".....             | 2 00            |
| Fred Fisher.....                              | ".....             | 2 00            |
| Matthew Buck.....                             | ".....             | 2 00            |
|   |                    | 172 85          |
| <i>Casual Revenue—Relief Advances.</i>        |                    |                 |
| Casual Revenue, repayments of Relief          |                    |                 |
| Mortgages and seed grain advances             |                    | 10,780 20       |
| Relief Mortgages 1876.....                    |                    | 847 86          |
| Seed Grain Advances, 1894.....                |                    | 1,380 47        |
| " 1896.....                                   |                    | 344 64          |
| " 1900.....                                   |                    | 95 47           |
| " 1901.....                                   |                    | 716 68          |
| " 1905.....                                   |                    | 1,050 15        |
|   |                    | 4,435 27        |
|   |                    | 26,224 29       |

CHAS. H. BEDDOE,  
*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## H.—STATEMENT showing Repayments on account of Seed Grain Advances and Relief Mortgages for the Fiscal Year ended March 31, 1909.

|            | Seed Grain Advances, 1908. | Seed Grain Advances, 1905. | Seed Grain Advances, 1901. | Seed Grain Advances, 1900. | Seed Grain Advances, 1896. | Seed Grain Advances, 1895. | Seed Grain Advances, 1894. | Seed Grain to Settlers Account, 1890. | Territorial Account, 1886-87-88. | Relief Mortgages, 1876. | Total.    |
|------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|---------------------------------------|----------------------------------|-------------------------|-----------|
|            | \$ cts.                    | \$ cts.                    | \$ cts.                    | \$ cts.                    | \$ cts.                    | \$ cts.                    | \$ cts.                    | \$ cts.                               | \$ cts.                          | \$ cts.                 | \$ cts.   |
| Refunds .. | 45,719 32                  | 1,050 15                   | 716 68                     | 95 47                      | 344 64                     | 1,247 23                   | 1,380 47                   | 1,143 80                              | 1,045 24                         | 847 86                  | 53,590 86 |
|            | 1,314 78                   | 14 51                      | .....                      | 5 30                       | 6 60                       | 52 84                      | 18 54                      | 2 40                                  | 52                               | 90                      | 1,416 39  |
|            | 44,404 54                  | 1,035 64                   | 716 68                     | 90 17                      | 338 04                     | 1,194 39                   | 1,361 93                   | 1,141 40                              | 1,044 72                         | 846 96                  | 52,174 47 |

CHAS. H. BEDDOE,  
*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

SESSIONAL PAPER No. 25

I.—STATEMENT of Gross Receipts on account of Dominion Lands Revenue for the fiscal year ended March 31, 1909.

| Month.    | Homestead Fees. |      | Pre-emption & Purchased Homestead Fees. |      | Improvements. |      | General Sales of Lands. |      | Timber Pines. |      | Rental from Grazing Lands. |      | Export Mining Fees, Hay and Coal Lands, &c. |      | Rocky Mountains Park of Canada. |      | Survey Fees. |      | Map Sales, Rental, Office Fees, and Miscellaneous. |      | Total.       |      |
|-----------|-----------------|------|---|------|---------------|------|-------------------------|------|---------------|------|----------------------------|------|---|------|---------------------------------|------|--------------|------|--|------|--------------|------|
|           | \$              | cts. | \$                                      | cts. | \$            | cts. | \$                      | cts. | \$            | cts. | \$                         | cts. | \$  | cts. | \$                              | cts. | \$           | cts. | \$   | cts. | \$           | cts. |
| 1908.     |                 |      |   |      |               |      |                         |      |               |      |                            |      |   |      |                                 |      |              |      |  |      |              |      |
| April     | 29,085 00       |      |   |      | 6,441 49      |      | 27,584 20               |      | 24,739 94     |      | 1,495 11                   |      | 8,999 21                                    |      | 2,709 79                        |      | 167 92       |      | 955 52   |      | 102,848 18   |      |
| May       | 27,635 00       |      |   |      | 8,713 88      |      | 25,908 40               |      | 32,546 24     |      | 3,423 83                   |      | 14,472 90                                   |      | 2,811 07                        |      | 104 73       |      | 5,169 07   |      | 121,083 52   |      |
| June      | 32,115 00       |      |   |      | 6,636 56      |      | 36,534 66               |      | 18,425 02     |      | 4,493 32                   |      | 35,039 18                                   |      | 1,988 29                        |      | 224 97       |      | 3,435 59   |      | 138,802 59   |      |
| July      | 28,030 00       |      |   |      | 5,245 70      |      | 30,778 18               |      | 22,062 72     |      | 2,997 51                   |      | 30,920 79                                   |      | 4,637 20                        |      | 78 76        |      | 2,929 99   |      | 127,656 85   |      |
| August    | 18,544 00       |      |   |      | 5,463 80      |      | 86,835 79               |      | 13,218 16     |      | 9,908 35                   |      | 25,745 98                                   |      | 9,219 37                        |      |              |      | 826 88   |      | 152,792 33   |      |
| September | 79,095 00       |      |   |      | 5,325 05      |      | 93,713 57               |      | 20,318 44     |      | 2,133 29                   |      | 26,423 54                                   |      | 3,622 25                        |      | 41,012 77    |      | 663 98   |      | 331,078 04   |      |
| October   | 52,135 00       |      |   |      | 4,319 74      |      | 40,380 15               |      | 19,835 29     |      | 4,135 49                   |      | 53,373 82                                   |      | 4,306 39                        |      | 273 06       |      | 934 41   |      | 263,283 26   |      |
| November  | 38,225 00       |      |   |      | 5,365 97      |      | 103,302 65              |      | 19,080 56     |      | 5,385 98                   |      | 12,812 18                                   |      | 629 50                          |      |              |      | 879 90   |      | 199,940 84   |      |
| December  | 30,950 00       |      |   |      | 5,961 67      |      | 331,557 44              |      | 20,882 38     |      | 10,093 18                  |      | 7,934 95                                    |      | 1,005 42                        |      |              |      | 1,068 79   |      | 424,263 83   |      |
| 1909.     |                 |      |   |      |               |      |                         |      |               |      |                            |      |   |      |                                 |      |              |      |  |      |              |      |
| January   | 13,040 00       |      |   |      | 4,279 13      |      | 36,296 81               |      | 33,143 65     |      | 1,967 63                   |      | 14,776 57                                   |      | 2,048 75                        |      | 128 50       |      | 1,243 12   |      | 152,689 16   |      |
| February  | 13,610 00       |      |   |      | 6,490 89      |      | 65,475 56               |      | 27,855 17     |      | 3,426 94                   |      | 7,299 39                                    |      | 689 67                          |      |              |      | 19,123 76  |      | 147,911 38   |      |
| March     | 25,965 00       |      |   |      | 6,775 88      |      | 72,874 87               |      | 17,920 04     |      | 3,612 16                   |      | 15,063 66                                   |      | 4,643 50                        |      | 397 60       |      | 6,015 69   |      | 161,878 40   |      |
|           | 389,039 00      |      |   |      | 70,928 86     |      | 951,442 28              |      | 269,837 52    |      | 53,312 79                  |      | 252,472 17                                  |      | 31,321 20                       |      | 42,368 31    |      | 43,246 70  |      | 2,254,283 88 |      |

CHAS. H. BEDDOE,  
Superintending Accountant.

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

9-10 EDWARD VII., A. 1910

## J.—DOMINION LANDS REVENUE.

STATEMENT of Gross Receipts (Cash and Scrip) on account of Dominion Lands Revenue for the fiscal year ended March 31, 1909, compared with the previous fiscal year.

| Particulars.                        | Fiscal year ended March 31, 1909. |      | Fiscal year ended March 31, 1908. |      | Increase. |      | Decrease. |      | Net increase |      |
|-------------------------------------|-----------------------------------|------|-----------------------------------|------|-----------|------|-----------|------|--------------|------|
|                                     | §                                 | cts. | §                                 | cts. | §         | cts. | §         | cts. | §            | cts. |
| Dominion Lands Agencies.....        | 1,575,354                         | 23   | 1,082,693                         | 22   | 492,661   | 01   |           |      |              |      |
| Crown Timber Agencies.....          | 243,354                           | 88   | 456,053                           | 72   |           |      | 212,698   | 84   |              |      |
| Ray, Mining, Coal, Grazing, &c..... | 123,797                           | 12   | 82,274                            | 13   | 36,522    | 69   |           |      |              |      |
| Miscellaneous.....                  | 70,809                            | 42   | 180,587                           | 83   |           |      | 109,778   | 41   |              |      |
| Rocky Mountains Park.....           | 31,321                            | 20   | 27,232                            | 87   | 4,088     | 33   |           |      |              |      |
|                                     | 2,044,636                         | 85   | 1,833,842                         | 07   | 533,272   | 03   | 322,477   | 25   |              |      |
| Yukon Territory.....                | 233,041                           | 24   | 260,737                           | 10   |           |      | 27,695    | 86   |              |      |
|                                     | 2,277,678                         | 09   | 2,094,579                         | 17   | 533,272   | 03   | 350,173   | 11   | 183,008      | 92   |

NOTE—Increase in Dominion Lands revenue \$210,794.78.  
Decrease in Yukon Territory revenue \$27,695.86.

CHAS. H. BEDDOE,  
*Superintending Accountant.*

DEPARTMENT OF THE INTERIOR,  
ACCOUNTS BRANCH,  
OTTAWA, June 10, 1909.

## No. 30.

## REPORT OF THE ORDNANCE AND ADMIRALTY LANDS BRANCH.

DEPARTMENT OF THE INTERIOR,  
ORDNANCE AND ADMIRALTY LANDS BRANCH,  
OTTAWA, April 30, 1909.

W. W. CORY, Esq.,

Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit the following report upon the work in connection with this branch of the department covering the fiscal year ending March 31, 1909.

During the period covered by this report two sales of Ordnance lands by public auction were held, at Grand Falls, N.B., and Niagara-on-the-Lake, Ontario, respectively, a detailed report of which is given under the heading of these localities.

Regarding those properties previously sold or held under leases issued by the Imperial authorities, with the right of renewal and option of purchasing upon payment in cash of the amount of consideration money placed thereon, 16 full lots and 8 part lots situated in the several localities hereunder mentioned and in the annexed statement marked 'A,' have been paid for in full and letters patent issued therefor:—

(1) Chambly, P.Q.—Three lots, forming portions of the ordnance reserve situated within the limits of this village which were put up at public auction in 1905 and sold for the sum of \$950 were paid for in full and letters patent issued. The balance of purchase money received during the fiscal year was \$237.50.

## SESSIONAL PAPER No. 25

(2) Gloucester Township.—Sub-lot No. 21 of lot No. 21, Junction Gore, being a portion of the land in this township acquired for the purposes of the Rideau canal, but the same not being required for the use of the canal was transferred to this department to be dealt with in the usual manner. The lot in question was sold in 1905 for the sum of \$500, and the balance of purchase money amounting to \$100 having been paid within the last fiscal year, letters-patent were issued.

(3) Grand Falls, N.B.—A sale of ordnance lots was held in the town of Grand Falls in May last, at which six farm lots and twenty-two town lots were offered for sale. Three of the former were sold for the sum of \$246, and all the latter were disposed of at an average price of \$88.32 or a total of \$1,943. The total amount realized by this was \$2,189, one-fifth, or \$437.80, being paid on account.

Nine other lots, forming part of the reserve in this locality and sold at various dates for the sum of \$766.50 were paid for in full and letters-patent issued. The balance of purchase money received within the fiscal year was \$197.88.

(4) Montreal.—In accordance with the provisions of the Act, Chapter 51, passed last session, confirming the orders in council of December 6, 1905, and July 27, 1907, St. Helen's Island in the St. Lawrence river opposite the city, and part of the Logan farm, now known as Lafontaine Park, were sold to the city of Montreal for the sum of \$200,000. This sum was transferred to the credit of the Minister of Militia and Defence, as provided by the Act above mentioned.

(5) Niagara-on-the-Lake.—The five lots situated in this town, being part of the subdivision of the hospital lots, and which were withdrawn from sale in 1907, were again offered for sale by public auction in August last, and were sold for the sum of \$1,765, an average price of \$353 each and an advance of \$515 on the upset price; one-fifth of the purchase money, or \$353, being paid down at the time of sale.

Since the date of sale the balance of the purchase money on one of these lots was paid in full and letters-patent issued therefor.

(6) Ottawa.—The lots in this locality are leasehold properties held under provisions contained in the original leases issued by the Imperial authorities with the privilege of converting the leasehold rights into freehold upon payment in cash of the amount of consideration money placed thereon. Within the last fiscal year two whole lots and eight part lots were redeemed and letters-patent issued. The total sum received as consideration money was \$836.33.

The following statements are hereto annexed:—

A.—Statement giving the number of lots and part lots sold or redeemed; the amounts for which such lots were originally disposed of and the sums received during the fiscal year as instalments or balances of purchase money.

B.—Statement naming the various localities where ordnance lands are situated on account of which moneys have been received during the fiscal year.

C.—Statement showing the receipts each month of the fiscal year classified as fees, rent or interest equivalent to rent and principal.

D.—Statement showing amounts due and unpaid on account of purchase money and rent or interest. The total amount shown to be outstanding is \$61,632.92.

The correspondence and general routine work in connection with this branch average about the same as for the previous fiscal period. The number of letters received, registered and filed was 441; number of letters written, copied and indexed 452, which, together with 613 letters in the form of accounts and circulars sent out makes a total of 1,045 letters mailed from this branch, an increase of 74 over last year. There were also 56 reports upon various ordnance lands matters prepared and submitted. The number of assignments received, examined and registered during the period covered by this report was 25, an increase of 2; 22 draft letters-patent were prepared and one new lease was issued.

There are 239 accounts with purchasers and tenants of ordnance lands now open in the ledgers of this branch, an increase of 24, necessitated by the sales held within

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the past year at Grand Falls and Niagara; these have been carefully and regularly posted. The receipt book, cash book and monthly statement book have been diligently and carefully kept, and a monthly return of all moneys received regularly furnished to the accountant of the department.

I beg to supplement the foregoing report upon the work in connection with the ordnance and admiralty lands by a synopsis of the work carried on in this branch in connection with the copying, comparing, recording, printing, indexing and filing of all the orders in council passed from time to time effectively dealing with and regulating the various important matters relating to the administration of this department in its many branches.

The number of orders in council passed during the last year was about the same as that of the previous year, and the volume and importance of the work done in connection with these valuable departmental records, in order that they may be available for immediate reference, cannot be overestimated.

The orders in council, as received, are copied, compared and entered in the record book kept expressly for that purpose, and a requisition issued on the superintendent of printing for a printed supply sufficient for departmental requirements. The proof is carefully read and corrected, and when the printed copies are received they are checked off, numbered and filed for future use. An alphabetical index of the orders passed each year is prepared and printed and a number of volumes of the orders bound for convenience of reference, and distributed among the various branches of the department.

Since the date of the last report the bound volumes of orders in council for the year 1904 were received and distributed among the several branches of the department; an index for the orders for 1905 prepared and printed, while the orders for that year have been collected and checked preparatory to being bound and are almost ready to be placed in the hands of the binder.

Orders in council altering or amending any of the existing regulations are, in accordance with the provisions of the Dominion Lands Act, published for four consecutive weeks in the *Canada Gazette*, and those affecting lands in the railway belt are, in addition, published in *British Columbia Gazette* for a similar period, and a return of these orders is made to the Senate and House of Commons within the first fifteen days after the opening of each session of parliament.

A record of the attendance of the numerous officials in the department is also carefully and regularly kept.

I have the honour to be, Sir,

Your obedient servant,

JOS. P. DUNNE,  
*Clerk in Charge of Ordnance  
and Admiralty Lands.*

## SESSIONAL PAPER No. 25

A.—STATEMENT giving the number of Lots and part Lots sold or redeemed; the amount for which such lots were originally disposed of and the sums received as instalments or balances of purchase money during the fiscal year ending March 31, 1909.

| Locality.              | Number of lots sold or redeemed.                             | Amount of consideration or purchase money. | Amount received on account during the fiscal year. | Remarks.   |
|------------------------|--|--|--|--|
|                        |  | \$ cts.                                    | \$ cts.  |  |
| Chambly .....          | 3 lots.....  | 950 00                                     | 237 50   | Balance of purchase money.                         |
| Gloucester.....        | 1 lot.....   | 500 00                                     | 100 00   | " " "  |
| Grand Falls.....       | 3 farm lots..  | 2,180 00                                   | 437 80   | First instalments.                                 |
| " .....                | 22 town lots..   |  |  |  |
| " .....                | 9 lots.....  | 766 50                                     | 197 88   | Balance of purchase money.                         |
| Montreal.....          | St. Helen's Is<br>land and part<br>of the Logan<br>farm..... | 200,000 00                                 | 200,000 00   | Purchase price in full.                            |
| Niagara-on-the-Lake... | 5 lots.....  | 1,765 00                                   | 629 00   | First instalment and balance<br>of purchase money. |
| Ottawa.....            | 2 whole lots..   | 836 33                                     | 836 33   | Consideration in full.                             |
| " .....                | 8 part lots..  |  |  |  |
| Refund .....           |  | 207,006 83                                 | 202,438 51   |  |
|                        |  | 200,000 00                                 | 200,000 00   |  |
|                        |  | 7,006 83                                   | 2,438 51   |  |

JOS. P. DUNNE,  
*Clerk in Charge of Ordnance and  
Admiralty Lands Branch.*

B.—STATEMENT naming the various localities where Ordnance Lands are situated on account of which moneys have been received during the fiscal year ending March 31, 1909.

| Locality.                | Amount.   | Locality.                | Amount.    |
|--------------------------|-----------|--------------------------|------------|
|                          | \$ cts.   |                          | \$ cts.    |
| Amherstburg.....         | 2 00      | Oxford.....              | 13 20      |
| Burlington Beach.....    | 280 00    | Prescott.....            | 2 00       |
| Chambly.....             | 250 38    | Quebec.....              | 800 00     |
| Edmundston.....          | 1 00      | Queenston.....           | 1 00       |
| Elmsley.....             | 4 60      | Sarnia.....              | 200 00     |
| Fort Cumberland.....     | 50 00     | Shelburne.....           | 3 00       |
| Fort Erie.....           | 22 00     | Sorel.....               | 358 72     |
| Gloucester.....          | 103 20    | Storrington.....         | 50 00      |
| Grand Falls.....         | 811 66    | St. Joseph's Island..... | 7 72       |
| Grenville.....           | 2 40      | Toronto.....             | 122 40     |
| Kingston.....            | 154 25    | Wolford.....             | 2 40       |
| Longueuil.....           | 250 00    | Registration fees.....   | 92 50      |
| Montreal.....            | 20,000 00 |                          |            |
| Niagara.....             | 353 00    |                          |            |
| Niagara-on-the-Lake..... | 281 75    | Less refund.....         | 205,747 46 |
| Oromocto.....            | 25        |                          | 200,037 30 |
| Ottawa.....              | 1,446 03  | Total.....               | 5,710 16   |
| Owen Sound.....          | 22 00     |                          |            |

JOS. P. DUNNE,  
*Clerk in Charge of Ordnance and  
Admiralty Lands Branch.*

9-10 EDWARD VII., A. 1910

C.—STATEMENT showing the Receipts each month of the fiscal year classified as fees, rent, or interest equivalent to rent, and principal.

| Month.                                 | Fees.   | Rent<br>or<br>Interest. | Principal. | Total.     |
|--|---------|-------------------------|------------|------------|
| 1908.                                  | \$ cts. | \$ cts.                 | \$ cts.    | \$ cts.    |
| April .....                            |         | 214 50                  | 66 00      | 280 50     |
| May .....                              |         | 109 30                  | 604 60     | 713 90     |
| June .....                             | 16 00   | 425 75                  | 285 00     | 726 75     |
| July .....                             | 8 00    | 860 53                  | 91 88      | 960 41     |
| August .....                           | 4 00    | 587 10                  | 353 50     | 944 10     |
| September .....                        | 2 00    | 33 45                   | 367 00     | 402 45     |
| October .....                          | 14 00   | 372 22                  | 92 50      | 478 72     |
| November .....                         | 2 00    | 38 00                   | 90 00      | 130 00     |
| December .....                         | 2 50    | 136 05                  | 111 33     | 249 88     |
| 1909.                                  |         |                         |            |            |
| January .....                          | 18 00   | 25 85                   | 366 00     | 409 85     |
| February .....                         | 8 00    | 194 70                  | 200,000 00 | 200,202 70 |
| March .....                            | 18 00   | 130 20                  | 100 00     | 248 20     |
|  | 92 50   | 3,127 65                | 202,527 31 | 205,747 46 |
| Less refund in month of May .....      |         |                         |            | 34 80      |
| Less refund in month of August .....   |         |                         |            | 2 50       |
| Less refund in month of February ..... |         |                         |            | 200,000 00 |
| Total .....                            |         |                         |            | 5,710 16   |

JOS. P. DUNNE,  
*Clerk in charge of  
 Ordnance and Admiralty Lands Branch.*



## SESSIONAL PAPER No. 25

D.—STATEMENT showing Amounts Due and unpaid on account of purchase money and rent or interest for the fiscal year ended March 31, 1909.

| Locality.             | Rent<br>or<br>Interest. | Principal. | Total.    |
|-----------------------|-------------------------|------------|-----------|
|                       | \$ cts.                 | \$ cts.    | \$ cts.   |
| Beaver Harbour.....   | 8 00                    |            | 8 00      |
| Burlington Beach..... | 120 00                  |            | 120 00    |
| Carillon.....         | 5 20                    |            | 5 20      |
| Chambly.....          | 275 49                  | 347 00     | 622 49    |
| Dalhousie.....        | 11 04                   | 23 00      | 34 04     |
| Edmunston.....        | 35 08                   | 38 40      | 73 48     |
| Elmsley.....          | 5 60                    |            | 5 60      |
| Fort Cumberland.....  | 156 00                  |            | 156 00    |
| Grand Falls.....      | 387 74                  | 972 02     | 1,359 76  |
| Kingston.....         | 108 39                  | 50 96      | 159 35    |
| Longueuil.....        | 2 00                    |            | 2 00      |
| Marlborough.....      | 1 00                    |            | 1 00      |
| Montreal.....         | 1 00                    |            | 1 00      |
| Nepean.....           | 52 00                   |            | 52 00     |
| Niagara.....          | 20 72                   | 53 60      | 74 32     |
| Oromocto.....         | 25                      |            | 25        |
| Ottawa.....           | 3,147 01                |            | 3,147 01  |
| Owen Sound.....       | 52 00                   |            | 52 00     |
| Oxford.....           | 4 00                    |            | 4 00      |
| Point Pelee.....      | 1 00                    |            | 1 00      |
| Presqu'isle.....      | 2 00                    |            | 2 00      |
| Sorel.....            | 1,185 28                |            | 1,185 28  |
| St. Croix River.....  | 2 00                    |            | 2 00      |
| Toronto.....          | 2,340 00                | 52,000 00  | 54,340 00 |
| Township of Tay.....  | 8 00                    |            | 8 00      |
| Turkey Point.....     | 37 34                   |            | 37 34     |
| Wolford.....          | 179 80                  |            | 179 80    |
|                       | 8,147 94                | 53,484 98  | 61,632 92 |

JOS. P. DUNNE,  
*Clerk in charge of  
 Ordnance and Admiralty Lands Branch.*

9-10 EDWARD VII., A. 1910

## No. 31.

## REPORT OF THE CORRESPONDENCE REGISTRATION BRANCH.

DEPARTMENT OF THE INTERIOR,  
CORRESPONDENCE REGISTRATION BRANCH,

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

OTTAWA, May 27, 1909.

SIR,—I have the honour to place before you statement A, showing the number of letters filed during the fiscal year ended March 31, 1909, and the amount of money received, registered and sent to the accountant; also statement B, showing the number of letters and the amount of money received during each fiscal year from 1900 to March 31, 1909.

There were 260,142 letters recorded during the year just closed, an increase of 38 per cent over 1908, but much mail matter, in the nature of simple acknowledgments of departmental communications, copies of letters from agents, requests for information usually supplied in pamphlets, &c., which formerly was registered, would, it is estimated, increase the number of letters received to 312,170, making a total average of more than a thousand a day.

Your obedient servant,

J. M. ROBERTS,  
*Chief of Branch.*

A.—STATEMENT showing the number of letters received and recorded and the money received during the Fiscal Year ended March 31, 1909.

|               | Letters Received. | Daily Average. | Registered Letters Received. | Registered Letters Sent. | Money Received. |
|---------------|-------------------|----------------|------------------------------|--------------------------|-----------------|
| 1908.         |                   |                |                              |                          | \$ cts.         |
| April...      | 15,215            | 634            | 1,664                        | 2,813                    | 91,114 67       |
| May.....      | 14,730            | 614            | 855                          | 2,510                    | 42,413 22       |
| June.....     | 19,240            | 740            | 1,054                        | 3,040                    | 73,120 02       |
| July.....     | 18,030            | 700            | 854                          | 3,024                    | 100,597 11      |
| August...     | 21,547            | 862            | 1,046                        | 3,252                    | 63,055 65       |
| September     | 18,410            | 735            | 803                          | 3,111                    | 49,332 04       |
| October...    | 24,525            | 908            | 908                          | 3,235                    | 127,554 67      |
| November      | 26,710            | 1,113          | 1,257                        | 4,094                    | 537,446 15      |
| December      | 27,155            | 1,131          | 1,373                        | 4,193                    | 165,255 06      |
| 1909.         |                   |                |                              |                          |                 |
| January.....  | 27,360            | 1,140          | 1,466                        | 4,168                    | 90,129 43       |
| February..... | 23,005            | 1,002          | 1,420                        | 3,998                    | 305,605 71      |
| March.....    | 24,215            | 897            | 1,810                        | 4,306                    | 132,652 44      |
| Total.....    | 260,142           |                | 14,510                       | 41,744                   | 1,798,276 17    |

J. M. ROBERTS,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
CORRESPONDENCE REGISTRATION BRANCH,  
OTTAWA, May 27, 1909.

## SESSIONAL PAPER No. 25

B.—STATEMENT showing the number of letters received and recorded and the money received during each Fiscal Year from 1900 to March 31, 1909.

| Fiscal Year.            | Letters<br>Received<br>and<br>Recorded. | Money<br>Received. |
|-------------------------|---|--------------------|
|                         |   | \$ cts.            |
| 1900.....               | 48,663                                  | 200,831 71         |
| 1901.....               | 67,860                                  | 333,534 02         |
| 1902.....               | 67,722                                  | 382,999 87         |
| 1903.....               | 87,851                                  | 629,585 47         |
| 1904.....               | 113,074                                 | 639,355 44         |
| 1905.....               | 135,908                                 | 528,219 76         |
| 1906.....               | 176,729                                 | 875,933 54         |
| 1907 (nine months)..... | 150,462                                 | 1,337,780 94       |
| 1908.....               | 187,684                                 | 1,558,230 32       |
| 1909.....               | 260,142                                 | 1,798,276 17       |

J. M. ROBERTS,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
CORRESPONDENCE REGISTRATION BRANCH,  
OTTAWA, May 27, 1909.

**No. 32.**

REPORT OF THE CORRESPONDENCE COMPARING AND MAILING  
OFFICE.

DEPARTMENT OF THE INTERIOR,  
CORRESPONDENCE COMPARING AND MAILING OFFICE,  
OTTAWA, April 19, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit to you herewith a statement showing the work done in the comparing and mailing office of the Department of the Interior during the fiscal year ended March 31, 1909.

I have the honour to be, sir,  
Your obedient servant,

CHAS. C. PELLETIER,  
*Clerk in Charge.*

9-10 EDWARD VII., A. 1910

## STATEMENT of the work done in the Comparing and Mailing Room during the Fiscal Year ended March 31, 1909.

| From April 1, 1908, to March 31, 1909.       | Letters Sent. | Registered Letters Sent. | Telegrams sent. | Totals. |
|--|---------------|--------------------------|-----------------|---------|
| 1908.  |               |                          |                 |         |
| April .....                                  | 23,340        | 2,813                    | 87              | 26,240  |
| May .....                                    | 24,453        | 2,510                    | 76              | 27,039  |
| June .....                                   | 25,874        | 3,040                    | 85              | 28,999  |
| July .....                                   | 23,986        | 3,024                    | 77              | 27,087  |
| August .....                                 | 25,564        | 4,298                    | 102             | 29,964  |
| September .....                              | 26,779        | 3,111                    | 230             | 30,120  |
| October .....                                | 28,345        | 3,235                    | 171             | 31,751  |
| November .....                               | 25,542        | 4,094                    | 202             | 29,838  |
| December .....                               | 25,923        | 4,193                    | 139             | 30,255  |
| 1909.  |               |                          |                 |         |
| January .....                                | 26,614        | 4,168                    | 114             | 30,896  |
| February .....                               | 29,390        | 3,998                    | 95              | 33,483  |
| March .....                                  | 38,712        | 4,306                    | 237             | 43,255  |
| Total for fiscal year ending March 31, 1909. | 324,522       | 42,790                   | 1,615           | 368,927 |

These outgoing letters were copied in 149 one-thousand paged letter-books, compared with 135 letter-books for the same period last year, or an increase of 10 per cent.

Besides the verifying of each letter and the checking of the thousands of enclosures accompanying them, there were 1,000 pages of documents, &c., compared during the year. The number of inclosures sent with the letters has augmented fully 35 per cent. This can be accounted for through the changes in the Dominion lands regulations and the issuing of volunteer bounty land warrants, the latter being responsible for a very large correspondence asking for information, both general and special, in relation thereto.

The number of pages of letter-books indexed was 148,046, compared with 131,367 last year; increase, 12½ per cent; almost every page was indexed in double entry.

The daily average of letters sent out was 1,083, an increase of more than 12 per cent over last year. The heaviest daily average was during the month of March, when it reached the total of 1,434, as many as 1,820 letters being sent out in one day. The lightest month was July, with an average of 888.

The grand total for this office during the fiscal year was 368,927, or an increase of 40,069 letters.

CHAS. C. PELLETIER,  
*Clerk in Charge.*

## No. 33.

## REPORT OF THE LAND PATENTS BRANCH.

DEPARTMENT OF THE INTERIOR,

LAND PATENTS BRANCH,

OTTAWA, May 25, 1909.

W. W. CORV, Esq.,

Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit for your information the statements hereinafter enumerated for the fiscal year ended March 31, 1909, in connection with the work performed in the Land Patents Branch.

A.—Statement showing the number of homestead entries as compared with the corresponding period of the previous year.

B.—Statement showing the number of pre-emptions, purchased homesteads and South African volunteer homesteads granted in each land agency.

C.—Statement of homesteads, pre-emptions, purchased homesteads, military homesteads and South African volunteer homesteads granted during each month.

D.—Statement showing the number of entries cancelled during the year, also the year in which such entries were made.

E.—Statement of entries affecting Dominion lands which were made at head office.

F.—Statement showing the number of acres of swamp lands in Manitoba transferred by order in council to the province of Manitoba.

G.—Statement showing South African volunteer bounty land certificates of 320 acres each issued under the Volunteer Bounty Act, 1908, by the Department of the Interior.

H.—Statement showing the number of assignments recorded in the Land Patents Branch.

I.—Statement of letters-patent covering Dominion lands situate in Manitoba, Saskatchewan, Alberta, British Columbia and the Yukon Territory.

J.—Statement of letters-patent covering Dominion lands situate in the province of Manitoba.

K.—Statement of letters-patent covering Dominion lands situate in the province of Saskatchewan.

L.—Statement of letters-patent covering Dominion lands situate in the province of Alberta.

M.—Statement of letters-patent covering Dominion lands situate in the province of British Columbia.

N.—Statement of letters-patent covering Dominion lands situate in the Yukon Territory.

O.—Statement showing the number of patents forwarded to the several registrars of the land registration districts of the provinces of Alberta and Saskatchewan and the Yukon Territory, and the number of notifications mailed to the patentees.

I have the honour to be, Sir,

Your obedient servant,

N. O. COTE,

*Chief of Branch.*

9-10 EDWARD VII., A. 1910

A.—STATEMENT showing the number of Homestead Entries made during the year ended March 31, 1909, as compared with the year ended March 31, 1908.

| Agency.               | 1909.  | 1908.  | Increase. | Decrease. | Remarks.                                       |
|-----------------------|--------|--------|-----------|-----------|--|
| Battleford .....      | 3,385  | 4,535  | .....     | 1,150     | } Net increase for fiscal year 1908-09, 8,657. |
| Brandon .....         | 171    | 90     | 81        | .....     |  |
| Calgary .....         | 2,707  | 1,278  | 1,429     | .....     |  |
| Dauphin .....         | 1,227  | 772    | 955       | .....     |  |
| Edmonton .....        | 5,166  | 4,055  | 1,111     | .....     |  |
| Estevan .....         | 833    | 502    | 331       | .....     |  |
| Humboldt .....        | 2,412  | 2,493  | .....     | 81        |  |
| Kamloops .....        | 400    | 195    | 205       | .....     |  |
| Lethbridge .....      | 3,818  | 2,456  | 1,362     | .....     |  |
| Moosejaw .....        | 8,710  | 5,181  | 3,529     | .....     |  |
| New Westminster ..... | 29     | 42     | .....     | 13        |  |
| Prince Albert .....   | 2,058  | 1,622  | 436       | .....     |  |
| Regina .....          | 1,553  | 1,653  | .....     | 100       |  |
| Red Deer .....        | 2,080  | 1,825  | 255       | .....     |  |
| Winnipeg .....        | 1,863  | 886    | 977       | .....     |  |
| Yorkton .....         | 2,169  | 2,839  | 670       | .....     |  |
| Total .....           | 39,081 | 30,424 | 10,671    | 2,014     |  |

## RECAPITULATION.

| Month.          | 1909.  | 1908.  | Increase. | Decrease. | Remarks.                                   |
|-----------------|--------|--------|-----------|-----------|--|
| January .....   | 1,308  | 1,453  | .....     | 145       | } Net increase fiscal year 1908-09, 8,657. |
| February .....  | 1,364  | 1,420  | .....     | 56        |  |
| March .....     | 2,592  | 1,869  | 723       | .....     |  |
| .....           | 1908.  | 1907.  | .....     | .....     |  |
| April .....     | 2,987  | 2,594  | 393       | .....     |  |
| May .....       | 2,773  | 3,253  | .....     | 480       |  |
| June .....      | 3,247  | 4,574  | .....     | 1,327     |  |
| July .....      | 2,815  | 3,690  | .....     | 875       |  |
| August .....    | 1,859  | 2,814  | .....     | 955       |  |
| September ..... | 7,934  | 2,395  | 5,539     | .....     |  |
| October .....   | 5,221  | 2,252  | 2,969     | .....     |  |
| November .....  | 3,876  | 2,261  | 1,615     | .....     |  |
| December .....  | 3,105  | 1,849  | 1,256     | .....     |  |
| Total .....     | 39,081 | 30,424 | 12,495    | 3,838     |  |

N. O. COTE,  
Chief of Branch.

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

## SESSIONAL PAPER No. 25

B.—STATEMENT showing the number of Pre-emptions, Purchased Homesteads and South African Veteran Homesteads granted in each Land Agency during the fiscal Year 1908-09 (from September 1, 1908, to March 31, 1909.

| Agency.            | Pre-emptions. | Purchased Homesteads. | South African Veteran Homesteads. |
|--------------------|---------------|-----------------------|-----------------------------------|
| Battleford .....   | 864           | 137                   | 13                                |
| Calgary .....      | 1,736         | 115                   | 73                                |
| Edmonton .....     | 44            | 2                     | 25                                |
| Estevan .....      | 911           | 57                    | .....                             |
| Humboldt .....     | 59            | 16                    | 18                                |
| Lethbridge .....   | 2,656         | 70                    | 43                                |
| Moosejaw .....     | 7,168         | 250                   | 98                                |
| Prince Albert..... | 62            | 54                    | 17                                |
| Regina.....        | 437           | 109                   | 5                                 |
| Red Deer.....      | 124           | 21                    | 38                                |
| Yorkton.....       | .....         | .....                 | 15                                |
| Total.....         | 14,061        | 831                   | 345                               |

| IN SASKATCHEWAN. |                       |                                   | IN ALBERTA.   |                       |                                   |
|------------------|-----------------------|-----------------------------------|---------------|-----------------------|-----------------------------------|
| Pre-emptions.    | Purchased Homesteads. | South African Veteran Homesteads. | Pre-emptions. | Purchased Homesteads. | South African Veteran Homesteads. |
| 9,501            | 623                   | 166                               | 4,560         | 208                   | 179                               |

NOTE—These grants were authorized by the Dominion Lands Act, which came into force September 1, 1908; and the Volunteer Bounty Act, assented to 20th July, 1908.

DEPARTMENT OF THE INTERIOR.

N. O. COTE,

LAND PATENTS BRANCH.

Chief of Branch.

OTTAWA, May 25, 1909.

C.—STATEMENT of Homesteads, Pre-emptions, Purchased Homesteads, Military Homesteads and South African Volunteer Homesteads granted during each month from April 1, 1908, to March 31, 1909.

| 1908.          | Homesteads. | Pre-emptions. | Purchased Homesteads. | Military Homesteads. | South African Volunteer Homesteads. |
|----------------|-------------|---------------|-----------------------|----------------------|-------------------------------------|
| April.....     | 2,987       | .....         | .....                 | .....                | .....                               |
| May.....       | 2,773       | .....         | .....                 | .....                | .....                               |
| June.....      | 3,247       | .....         | .....                 | .....                | .....                               |
| July.....      | 2,815       | .....         | .....                 | .....                | .....                               |
| August.....    | 1,859       | .....         | .....                 | .....                | .....                               |
| September..... | 7,934       | 7,374         | 445                   | .....                | .....                               |
| October.....   | 5,221       | 2,193         | 126                   | 1                    | .....                               |
| November.....  | 3,876       | 1,379         | 52                    | 1                    | 24                                  |
| December.....  | 3,105       | 1,334         | 58                    | 2                    | 55                                  |
| 1909.          |             |               |                       |                      |                                     |
| January.....   | 1,308       | 538           | 32                    | .....                | 74                                  |
| February.....  | 1,364       | 378           | 32                    | .....                | 52                                  |
| March.....     | 2,592       | 865           | 86                    | .....                | 140                                 |
|                | 39,081      | 14,061        | 831                   | 4                    | 345                                 |

DEPARTMENT OF THE INTERIOR.

N. O. COTE,

LAND PATENTS BRANCH.

Chief of Branch.

OTTAWA, May 25, 1909.

9-10 EDWARD VII., A. 1910

D.—STATEMENT showing the number of entries cancelled during the year ended March 31, 1909, also the year in which such entries were made.

| Year. | Homesteads. | Purchased Homesteads. | Pre-emptions. | Time-Sales. | Sales. |
|-------|-------------|-----------------------|---------------|-------------|--------|
| 1871  |             |                       | 1             |             |        |
| 1872  |             |                       |               |             |        |
| 1873  | 1           |                       |               |             |        |
| 1874  |             |                       | 1             |             | 1      |
| 1875  |             |                       |               |             |        |
| 1876  |             |                       |               |             |        |
| 1877  |             |                       |               |             |        |
| 1878  | 1           |                       | 3             |             | 1      |
| 1879  |             |                       |               | 1           |        |
| 1880  |             |                       | 1             |             |        |
| 1881  |             |                       |               |             |        |
| 1882  | 3           |                       | 2             |             |        |
| 1883  | 1           |                       | 6             |             |        |
| 1884  |             |                       | 7             |             |        |
| 1885  | 1           |                       | 4             |             |        |
| 1886  | 1           |                       | 3             |             |        |
| 1887  | 1           |                       | 1             |             |        |
| 1888  |             |                       |               |             |        |
| 1889  | 4           |                       | 7             |             |        |
| 1890  |             |                       |               |             |        |
| 1891  | 3           |                       |               |             |        |
| 1892  | 2           |                       |               |             | 1      |
| 1893  | 1           |                       |               |             |        |
| 1894  | 1           |                       |               |             |        |
| 1895  | 2           |                       |               |             | 1      |
| 1896  | 3           |                       |               |             |        |
| 1897  | 2           |                       |               | 1           |        |
| 1898  | 2           |                       |               |             |        |
| 1899  | 9           |                       |               |             |        |
| 1900  | 6           |                       |               | 1           |        |
| 1901  | 31          |                       |               |             | 1      |
| 1902  | 79          |                       |               |             |        |
| 1903  | 187         |                       |               |             |        |
| 1904  | 315         |                       |               | 1           | 1      |
| 1905  | 899         |                       |               |             | 1      |
| 1906  | 2,925       |                       |               | 1           | 5      |
| 1907  | 5,532       |                       |               | 1           |        |
| 1908  | 4,647       | 21                    | 219           |             |        |
| 1909  | 18          |                       | 5             |             |        |
|       | 14,677      | 21                    | 260           | 6           | 12     |

N. O. COTE,  
Chief of Branch.

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.



## SESSIONAL PAPER No. 25

E.—STATEMENT of entries affecting Dominion Lands which were made at Head Office for the year ended March 31, 1909.

|   | No. of Grants | Aeres.       |
|---|---------------|--------------|
| Special grants.. . . . .  | 352           | 4,217.00     |
| Alberta Railway and Irrigation Company.. . . .                                    | ....          | 50,603.25    |
| Calgary and Edmonton Railway Company... . . . .                                   | ....          | 20,340.10    |
| Canadian Northern Railway Company.. . . .   | ....          | 231,826.88   |
| Canadian Pacific Railway Co., Main Line.. . . .                                   | ....          | 53,105.45    |
| Canadian Pacific Railway Co., Souris Br.. . . .                                   | ....          | 470.75       |
| Canadian Pacific Railway Company, Pipestone extension, Souris Branch.. . . . .    | ....          | 1,744.65     |
| Manitoba and South Eastern Railway Co.. . . . .                                   | ....          | 2,313.26     |
| Manitoba Southwestern Colonization Railway Company.. . . . .                      | ....          | 497,538.72   |
| Qu'Appelle, Long Lake and Saskatchewan Railroad and Steamboat Company . . . . .   | ....          | 1,693.19     |
| Area sold and patented to the Grand Trunk Pacific Railway for townsites.. . . . . | ....          | 12,905.45    |
| Area granted to the Grand Trunk Pacific Railway for right of way.. . . . .        | ....          | 3,534.46     |
| Railway right of way.. . . . .  | 96            | 2,483.77     |
| Hudson's Bay Company's grants.. . . . .   | 30            | 133,696.00   |
|   |               | <hr/>        |
|   |               | 1,016,472.93 |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

F.—STATEMENT showing the number of Acres of Swamp Lands in Manitoba transferred by Order in Council to the Province of Manitoba, up to March 31, 1909.

|   | Aeres.       |
|---|--------------|
| Total area transferred to March 31, 1908.. . . .                          | 1,917,808.69 |
| No lands were transferred during the year ending March 31, 1909.. . . . . | .....        |
|   | <hr/>        |
|   | 1,917,808.69 |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

G.—STATEMENT showing South African Volunteer Bounty Land Certificates of 320 acres each issued under the Volunteer Bounty Act, 1908, by the Department of the Interior up to and including March 31, 1909.

|                                | No.   | Aeres.    |
|--------------------------------|-------|-----------|
| Certificates issued.. . . . .  | 5,279 | 1,689,280 |
| Certificates located.. . . . . | 345   | 110,400   |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

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H.—STATEMENT showing the number of Assignments recorded in the Land Patents Branch during the year ended March 31, 1909.

|  |          |
|--|----------|
| Number of deeds registered. . . . .            | 239      |
| Fees received in connection therewith. . . . . | \$476 50 |

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

N. O. COTE,  
*Chief of Branch.*

I.—STATEMENT of Letters-Patent covering Dominion Lands situate in Manitoba, Saskatchewan, Alberta, British Columbia and the Yukon Territory issued from the Department of the Interior during the Fiscal Year ending March 31, 1909, as compared with the fiscal Year ending March 31, 1908.

| Nature of Grant.  | FROM APRIL 1, 1908,<br>TO MARCH 31, 1909. |           | FROM APRIL 1, 1907,<br>TO MARCH 31, 1908. |           |
|---|---|-----------|---|-----------|
|   | Patents.                                  | Acres.    | Patents.                                  | Acres.    |
| 1. Alberta Railway and Irrigation Co. sales. . . . .                          | 44  | 15,531    | 29  | 17,932    |
| 2. Assignment of mortgages . . . . .  | 10  |           |   |           |
| 3. British Columbia homesteads . . . . .                                      | 103                                       | 14,903    | 102                                       | 14,783    |
| 4. British Columbia sales. . . . .  | 24  | 1,603     | 49  | 2,739     |
| 5. Coal lands sales, under rights (1,379 acres). . . . .                      | 34  | 8,460     | 36  | 7,903     |
| 6. Commutation grants. . . . .  | 8   | 331       | 6   | 281       |
| 7. Half-breed allotments . . . . .  |   |           | 1   | 240       |
| 8. Homesteads . . . . .   | 19,929                                    | 3,159,779 | 14,506                                    | 2,300,706 |
| 9. Hudson's Bay Company. . . . .  | 16  | 3,296     | 3   | 1,761     |
| 10. Leases. . . . .   | 1   | 516       | 3   |           |
| 11. License of occupation. . . . .  | 13  |           | 6   |           |
| 12. Manitoba Act grants. . . . .  | 14  | 842       | 4   | 117       |
| 13. Manitoba University grants . . . . .                                      | 6   | 891       |   |           |
| 14. Military bounty grants. . . . .   | 1   | 160       |   |           |
| 15. Military homesteads. . . . .  | 1   | 320       | 9   | 2,872     |
| 16. Mineral rights (18,194.38 acres). . . . .                                 | 91  |           | 39  |           |
| 17. Mining lands sales. . . . .   | 1   | 8         | 6   | 102       |
| 18. Northwest half-breed grants . . . . .                                     | 131                                       | 22,861    | 220                                       | 37,255    |
| 19. Parish sales . . . . .  | 12  | 1,311     | 6   | 1,546     |
| 20. Quit claim, special grants (2,955 09 acres). . . . .                      | 18  |           | 12  |           |
| 21. Railways—   |   |           |   |           |
| 20A. Alberta Railway and Irrigation Company . . . . .                         | 3   | 46,067    |   |           |
| 21. Alberta Railway and Coal Co . . . . .                                     | 3   | 4,644     |   |           |
| 22. Calgary and Edmonton Railway Co . . . . .                                 | 24  | 20,418    | 93  | 85,975    |
| 23. Calgary and Edmonton Railway Co., under rights. . . . .                   |   |           | 9   |           |
| 24. Canadian Northern Railway Co. . . . .                                     | 234                                       | 233,388   | 1,330                                     | 2,138,422 |
| 25. Canadian Pacific Railway grants . . . . .                                 | 79  | 53,745    | 216                                       | 377,427   |
| 26. Canadian Pacific Railway grants, Souris branch . . . . .                  | 11  | 2,215     | 50  | 94,611    |
| 27. Canadian Pacific Railway roadbed and station grounds . . . . .            | 6   | 131       | 76  | 1,062     |
| 28. Grand Trunk Pacific Railway . . . . .                                     | 287                                       | 15,793    | 33  | 361       |
| 29. Manitoba and Southeastern Railway Co. . . . .                             | 8   | 2,313     | 471                                       | 676,160   |
| 30. Manitoba and Northwestern Railway Co. . . . .                             | 2   | 14        | 34  | 29,421    |
| 31. Manitoba Southwestern Colonization Railway Co. . . . .                    | 215                                       | 497,693   | 192                                       | 52,779    |
| 32. Qu'Appelle, Long Lake and Saskatchewan Railroad and Steamboat Co. . . . . | 11  | 1,783     | 10  | 5,911     |
| 33. Saskatchewan and Western Railway . . . . .                                |   |           | 43  | 98,886    |
| 34. Sales . . . . .   | 557                                       | 72,349    | 607                                       | 159,050   |
| 35. School lands sales . . . . .  | 240                                       | 27,195    | 189                                       | 21,949    |
| 36. Special grants . . . . .  | 166                                       | 4,500     | 204                                       | 6,579     |
| 37. Special grants, under rights (41,538 acres). . . . .                      | 71  |           |   |           |
| 38. Yukon Territory sales . . . . .   | 57  | 2,236     | 65  | 2,147     |
| 39. Yukon Territory specials. . . . .   |   |           | 1   |           |
| Totals. . . . .   | 22,431                                    | 4,215,326 | 18,690                                    | 6,138,977 |

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

N. O. COTE,  
*Chief of Branch.*

## SESSIONAL PAPER No. 25

J.—STATEMENT of Letters-Patent covering Dominion Lands situate in the Province of Manitoba, issued from the Department of the Interior during the Fiscal Year ending March 31, 1909.

| Nature of Grant.  | No. of Patents. | No. of Acres. |
|---|-----------------|---------------|
| Assignment of mortgages.....                              | 10              |               |
| Coal lands sales.....                                     | 4               | 831           |
| Commutation grants.....                                   | 8               | 331           |
| Homesteads.....   | 1,013           | 156,621       |
| Manitoba Act grants.....                                  | 14              | 842           |
| Manitoba University grants.....                           | 6               | 891           |
| Northwest half-breed grants.....                          | 1               | 80            |
| Parish sales.....   | 11              | 1,165         |
| Railways—   |                 |               |
| Canadian Northern Railway Co.....                         | 47              | 31,883        |
| Canadian Pacific Railway grants.....                      | 4               | 658           |
| Canadian Pacific Railway roadbed and station grounds..... | 1               | 25            |
| Grand Trunk Pacific Railway.....                          | 2               | 23            |
| Manitoba and Southeastern Railway Co.....                 | 5               | 1,200         |
| Manitoba Southwestern Colonization Railway Co.....        | 111             | 160,783       |
| Sales.....  | 133             | 7,083         |
| School lands sales.....                                   | 130             | 19,010        |
| Special grants.....                                       | 11              | 703           |
| Total.....  | 1,511           | 382,129       |

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

N. O. COTE,  
*Chief of Branch.*

K.—STATEMENT of Letters-Patent covering Dominion Lands situate in the Province of Saskatchewan, issued from the Department of the Interior during the fiscal Year ending March 31, 1909.

| Nature of Grant.  | No. of Patents. | No. of Acres. |
|---|-----------------|---------------|
| Coal lands sales.....   | 1               | 20            |
| Homesteads.....   | 13,054          | 2,072,668     |
| Hudson's Bay Co.....  | 16              | 3,296         |
| Leases.....   | 1               | 516           |
| License of occupation.....  | 6               |               |
| Military homesteads.....  | 1               | 320           |
| Mineral rights (320 acres).....                                       | 1               |               |
| Northwest half-breed grants.....                                      | 60              | 10,420        |
| Parish sales.....   | 1               | 146           |
| Quit claim, special grants (2,955.09 acres).....                      | 18              |               |
| Railways—   |                 |               |
| Canadian Northern Railway.....  | 185             | 201,272       |
| Canadian Pacific Railway grants.....                                  | 29              | 5,060         |
| Canadian Pacific Railway grants, Souris branch.....                   | 10              | 2,015         |
| Grand Trunk Pacific Railway grants.....                               | 247             | 12,229        |
| Manitoba and Northwestern Railway.....                                | 2               | 14            |
| Manitoba Southwestern Colonization Ry. Co.....                        | 83              | 138,787       |
| Manitoba and Southeastern Railway.....                                | 3               | 1,113         |
| Qu'Appelle, Long Lake and Saskatchewan Railroad and Steamboat Co..... | 11              | 1,783         |
| Sales.....  | 263             | 41,549        |
| School lands sales.....   | 88              | 6,494         |
| Special grants.....   | 96              | 1,588         |
| Special grants, under rights (29, 831.99 acres).....                  | 48              |               |
| Total.....  | 14,224          | 2,499,290     |

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

N. O. COTE,  
*Chief of Branch.*

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L.—STATEMENT of Letters-Patent covering Dominion Lands situate in the Province of Alberta, issued from the Department of the Interior during the fiscal year ending March 31, 1909.

| Nature of Grant.                                    | No. of Patents. | No. of Acres. |
|---|-----------------|---------------|
| Alberta Railway and Irrigation Company sales .....  | 47              | 61,598        |
| Coal lands sales .....                              | 29              | 7,609         |
| Homesteads .....                                    | 5,862           | 930,491       |
| License of occupation .....                         | 7               | .....         |
| Military bounty grants .....                        | 1               | 160           |
| Mineral rights (17,874.38 acres) .....              | 90              | .....         |
| Mining lands sales .....                            | 1               | 8             |
| Northwest half-breed grants .....                   | 70              | 12,361        |
| Railways—   |                 |               |
| Alberta Railway and Coal Co. ....                   | 3               | 4,644         |
| Calgary and Edmonton Railway Co. ....               | 24              | 20,448        |
| Canadian Northern Railway Co. ....                  | 2               | 234           |
| Canadian Pacific Railway grants .....               | 46              | 48,026        |
| " " " " (Souris branch). ....                       | 1               | 200           |
| Grand Trunk Pacific Railway .....                   | 38              | 3,541         |
| Manitoba Southwestern Colonization Railway Co. .... | 21              | 198,122       |
| Sales .....   | 141             | 23,717        |
| School lands sales .....                            | 22              | 1,691         |
| Special grants .....                                | 59              | 2,210         |
| " " under rights (11,706.51 acres) .....            | 23              | .....         |
| Total .....   | 6,507           | 1,315,060     |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

M.—STATEMENT of Letters-Patent covering Dominion Lands situate in the Province of British Columbia, issued from the Department of the Interior during the fiscal year ending March 31, 1909.

| Nature of Grant.  | No. of Patents. | No. of Acres. |
|---|-----------------|---------------|
| British Columbia homesteads .....                                   | 103             | 14,903        |
| " " sales .....   | 24              | 1,603         |
| Railways—Canadian Pacific Railway roadbed and station grounds ..... | 5               | 105           |
| Total .....   | 132             | 16,611        |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

## SESSIONAL PAPER No. 25

N.—STATEMENT of Letters-Patent covering Dominion Lands situate in the Yukon Territory, issued from the Department of the Interior during the fiscal year ending March 31, 1909.

| Nature of Grant.           | No. of Patents. | No. of Acres. |
|----------------------------|-----------------|---------------|
| Yukon Territory sales..... | 57              | 2,236         |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

O.—STATEMENT showing the number of patents forwarded to the several registrars of the land registration districts of the Province of Alberta, Saskatchewan and Yukon Territory, and the number of notifications mailed to patentees during the year, April 1, 1908, to March 31, 1909, inclusive.

| Registration District. | No. of Patents sent to Registrars. | No. of Notifications mailed to Patentees. |
|------------------------|------------------------------------|---|
| Assiniboia.....        | 8,839                              | 8,851                                     |
| Yorkton.....           | 1,213                              | 1,283                                     |
| East Saskatchewan..... | 2,638                              | 2,697                                     |
| West Saskatchewan..... | 1,511                              | 1,603                                     |
| North Alberta.....     | 3,420                              | 3,396                                     |
| South Alberta.....     | 3,031                              | 3,045                                     |
| Yukon.....             | 46                                 | 51  |
| Total .....            | 20,698                             | 20,926                                    |

N. O. COTE,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
LAND PATENTS BRANCH,  
OTTAWA, May 25, 1909.

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## No. 34.

## REPORT OF THE CHIEF GEOGRAPHER.

DEPARTMENT OF THE INTERIOR,

OFFICE OF THE CHIEF GEOGRAPHER,

OTTAWA, March 31, 1909.

W. W. CORY, Esq.,

Deputy Minister of the Interior.  
Ottawa.

SIR,—I have the honour to report as follows on the work of my office for the past year.

The staff as constituted under the new Civil Service Act is as follows:—

*Division I.—Grade B.*

Chalifour, J. E., Chief Draughtsman.

*Division II.—Grade A.*Baine, H. E.  
Taché, Henri.  
Anderson, W.Inkster, Fred.  
Bryant, E. D.  
Beveridge, Jas.*Division II.—Grade B.*Akerlindh, A.  
Grindlay, T.  
Darrach, A. M.  
Blatchly, H.  
Dumouchel, G. E.  
Wilson, H. W.  
Chandler, S.Bennie, J.  
Craig, R. W.  
Groulx, A.  
McElligott, J.  
Blue, W. A.  
Pigeon, J. H.*Division III.—Grade A.*

Waine, Mrs. D. E.

Gagnon, J. S.

*Division III.—Grade B.*

Stewart, Miss Mary.

Merrifield, J. R.

Miss Mary Stewart was appointed May 1, 1908, to assist in the stenographic work and typewriting.

Mr. T. Grindlay was appointed August 11, 1908, and has since been employed on the Northern British Columbia and Nova Scotia 'Standard' sheets.

Mr. C. G. Wood, who was appointed January 2, 1903, died on February 23, 1909. Mr. Wood was an accurate and painstaking official whose kindly disposition endeared him to all with whom he came in contact.

The routine work of the office has been carried on as usual and a number of the 'Standard' topographical sheets are either completed or are nearing completion.

Sheet 11.—Montreal and Quebec sheet, has been delivered.

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Sheet 28.—English River sheet, colour proofs have been received and it will be printed shortly.

Sheet 2, N.E.—Belleville sheet, has been transferred and preliminary proofs from stone have been received.

Sheet 7, N.E.—Sault Ste. Marie sheet, 8 S.W.—Manitoulin sheet, 14 S.E.—Truro sheet, 5 N.W.—Halifax sheet, 14 S.W.—Springhill sheet, 14 S.E.—Charlottetown sheet, 31 S.E.—Abitibi sheet and 30 Missinaibi sheet are in the hands of the engravers.

Sheet 9, S.E.—Pembroke sheet, 10 S.W.—Ottawa sheet, 10 S.E.—Cornwall sheet, 3 N.W.—Kingston sheet, are nearly completed and will be issued at an early date.

The compilation of sheets 41, 42, 43, 44 and 45, covering the area traversed by the Grand Trunk Pacific in northern British Columbia, has been, perforce, suspended, pending the filing of the final location of the railway. As it is the only chained line through this area, it must serve as a base-line upon which the compilation of the other material will be made.

During the year, new editions of the maps of Manitoba, Saskatchewan, Southern Alberta and Northern Alberta have been prepared. Maps of the Winnipeg, Dauphin, Estevan, Humboldt, Yorkton, Prince Albert, Regina, Moosejaw, Battleford, Edmonton, Red Deer, Calgary and Lethbridge land districts were published for use by the agents of these districts. These maps give the available number of quarter-sections in each township, quality of the soil, &c. Similar maps are also required for the new districts of Saskatoon and Peace River.

An 'Elevator' map giving the elevator capacity at each station in Manitoba, Saskatchewan and Alberta has been published. It also contains tabular lists, arranged alphabetically under provinces, of the capacities of the elevators and of the flour and cereal mills in the west. The so-called three-sheet map of Manitoba, Saskatchewan and Alberta has been extended westward to the western boundary of the last-named province and is now, virtually, a four-sheet map.

In connection with the case of Great Britain respecting the North Atlantic fisheries, to be argued before the Hague tribunal during the coming summer, 16 maps and plans were prepared illustrating the main points in the British contention.

On September 5, I left Ottawa to join the excursion of the Canadian Mining Institute to the mines of Central and Western Canada. In 1907 the Canadian Mining Institute issued invitations to the Institution of Mining and Metallurgy, the Iron and Steel Institute, the Institution of Mining Engineers, the South Wales Institute of Engineers, the Mining Institute of Scotland and the Manchester Geological and Mining Society in Great Britain; L'Association des Elèves des Ecoles Spéciales, in Belgium; L'Association Amicale des Elèves de l'Ecole Nationale Supérieure des Mines, in France; and the Verein Deutscher Eisenhüttenleute in Germany, to appoint official delegates to come to Canada and take part in the excursion as the guests of the Canadian Mining Institute; while a general invitation was issued to the members of these respective societies to join the excursion on the same terms as members of the institute. The invitation was accepted by about thirty-five.

Prior to my joining the party, they had visited the coal mines and steel plants at Sydney and North Sydney, N.S., the asbestos and chrome-iron mines of the Eastern Townships, the hydro-electric power plants at Niagara Falls and the silver-cobalt mines at Cobalt.

On September 7 we left Sudbury for the Moose Mountain mines. At this point the Canadian Northern Company is developing iron properties and, at Key Harbour, on Georgian Bay, has constructed extensive docks, evidently intending to export the ore to the United States. On the return trip a short stop was made at Vermilion river to permit some of the party to test the gravel. A few 'colours' were obtained.

The following day, the smelter and the Crean Hill copper-nickel mine of the Canadian Copper Company were visited. The smelter contains five furnaces; total capacity 2,500 tons daily. The furnaces are fed by electric trains of charging cars

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with a capacity of 3,000 lbs. each. The plant is operated by electric energy generated at the High Falls of the Spanish river, 27 miles distant.

The Crean Hill mine, at present, consists of an open pit about 200 feet in diameter and 100 feet deep with four underground stopes below the pit floor. About 12,000 tons of ore carrying approximately 4 per cent copper and 2 per cent nickel, are shipped per month. On the return journey a visit was paid to the Mond Nickel Company's smelter at Victoria Mines.

On the 13th, Medicine Hat was reached and its famous natural gas well visited. We were informed that gas is supplied to the householder for 13½ cents per 1,000 cubic feet and to the manufacturer for 5 cents. It is used in practically all the houses for illumination and in ranges and furnaces for heating. At this point Mr. E. Coste, under whose supervision the well was driven, gave an exhibition of the gas escaping burning and unburnt under a pressure of 600 lbs. to the square inch.

The following morning, the great rock slide at Frank was visited. Later, the party entered the mine of the International Coal and Coke Company, the time at their disposal permitting only a brief visit. The present output is about 2,000 tons per day. About one-half is sold to the Canadian Pacific Railway Company for locomotive use; the balance is converted into coke and sold to the British Columbia Copper Company, Greenwood, for its smelter. The estimated tonnage of available coal in the International Coal and Coke Company's mines is estimated at 50,000,000 tons. The length of the main entry in No. 2 seam is 9,000 feet.

Arriving at Hosmer at noon, the new plant of the Hosmer Mines, Ltd.—a subsidiary corporation of the Canadian Pacific—was examined. At the date of our visit, actual coal mining had not begun, the company being debarred from mining during the continuance of an agreement with the Crownsnest Pass Coal Company. The agreement expired in December last, and mining is now in progress and, when fully developed, will have a capacity of 4,000 tons per day. There are 240 beehive coke ovens with a total capacity of 300 tons per day.

Between Michel and Fernie the line traverses the area then recently swept by the great Fernie fire. Of the town of Fernie, naught remained except the coal company's offices and a half dozen houses. Everywhere rebuilding was being rushed, the population, in the meantime, living and transacting business in tents and hastily erected wooden structures.

In the afternoon the Coal Creek mines of the Crownsnest Pass Coal Company were visited. The company owns approximately 240,000 acres of coal lands. The coal is a high grade bituminous, makes an excellent coke and is a steam coal of unexceptionable quality. The present output is about 4,000 tons per day. The company owns 1,128 beehive ovens, with a total daily capacity of upwards of 2,000 tons of coke, which is sold to smelters in British Columbia and in the state of Washington.

On the 17th the St. Eugène mine and mill at Moyie were visited. The St. Eugène is the largest silver-lead mine in Canada; is owned and operated by the Consolidated Mining and Smelting Company. The crude ore averages about 18 per cent lead, but the concentrates shipped to the Trail smelter contain 65 per cent lead and 32 ounces of silver per ton. In 1907 the 125,000 tons of ore mined contained 607,000 ounces of silver and 27,000,000 pounds of lead.

As the power plant at Bonnington Falls was not reached till 11 p.m., the late hour prevented an extended examination. The West Kootenay Power Company operates this plant and supplies electrical energy to the Rossland, Phoenix and Greenwood districts and to the smelters at Trail, Grand Forks, Greenwood and Boundary Falls. There are 4 main units of 8,000 horse-power each, operating under a head of 70 feet.

The morning of the 16th was spent at the Trail smelter, owned by the Consolidated Mining and Smelting Company. The plant contains five copper blast furnaces with a combined capacity of 1,600 tons and two lead blast furnaces having a combined capacity of 350 tons of lead ore. The copper-gold matte from the furnaces is treated



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by the Huntington-Heberlein process, resmelted and concentrated to approximately 45 per cent copper and to 25 ounces of gold to the ton. The lead refinery has a daily capacity of 75 tons of, practically, pure lead. Part of the refined lead is manufactured into lead pipe and the balance shipped to the Orient. Copper sulphate is produced and shipped to Manitoba, Saskatchewan and Alberta where it is used for cleaning wheat.

In the year ending June 30, 1908, the smelter produced 121,380 ounces of gold, 2,224,888 ounces of silver, 32,157,139 pounds of lead and 4,004,468 pounds of copper, with a total value of \$5,428,501.

Arriving at Rossland at noon, the party divided to visit the Le Roi, Centre Star and War Eagle mines. The souvenir booklet, presented by the entertainment committee, gives the following statistics:—Le Roi mine, gross value of mineral output, 1894-1908, \$20,406,627; maximum depth of shaft, 1,700 feet, and total development, 21 miles. Consolidated Mining and Smelting Company, operating Centre Star, War Eagle and other mines, gross value of output, \$15,948,133; maximum depth of shaft, 2,200 feet, and total development, 19 miles. Le Roi No. 2, output, 1900-08, \$4,413,663, deepest working, 850 feet, and development work, 7 miles.

On September 17, the British Columbia Copper Company's Mother Lode mine and smelter at Greenwood were visited. The ore body is a low-grade copper deposit, approximately 2,000 feet long and from 80 to 110 feet wide, carrying values of \$4.50 to \$6 per ton. The present plant—which was being enlarged at the time of my visit in 1906—contains 3 large furnaces with a capacity of about 700 tons each per day. The blister copper produced is practically free from objectionable impurities and runs 99 per cent fine.

On the morning of the 18th, the party arrived at Phoenix, receiving a royal salute of twenty-one blasts on Granby hill. After inspecting the shaft-houses, compressor building and 'glory-hole,' a trip was made into the mine in cars hauled by an electric locomotive and the visitors were informed that there were, approximately, 20,000,000 tons of ore in sight. In the year ending June 30, 1908, the Granby mines produced 21,126,926 pounds of copper, 300,593 ounces of silver and 40,139 ounces of gold; gross value \$3,790,184. In the afternoon the Granby smelter at Grand Forks, was visited.

On the 19th, a fruit farm on Kootenay lake was visited and, in the afternoon, the Blue Bell mine and concentrator, now being operated by the Canadian Metal Company, were inspected. The deposit—notable for its extent—is chiefly low-grade galena with pyrrhotite, &c., and has been developed by open cuts and by a tunnel driven into the hillside. The lead mill has a capacity of 200 tons per day.

On the 22nd, a meeting of the western branch of the institute was held at Victoria and the visitors were welcomed by the Hon. Richard McBride, Premier of British Columbia, and Hon. Wm. Templeman, Minister of Mines for the Dominion.

On the 26th, the party left Victoria for Nanaimo, stopping at Ladysmith for a hurried visit to the Tyee Copper Co.'s smelter, which was, at that time, operating on custom ore, principally from the Japanese copper mine on the Queen Charlotte islands. At Nanaimo the Western Fuel Co.'s No. 1 shaft and Northfield (No. 4) Brechin mine were visited, also the Hamilton Powder Co.'s powder manufactory at Departure Bay. The No. 1 and Northfield mines are at present producing 600,000 or 700,000 tons per annum.

On the 27th, the Bankhead mines, near Banff, were visited. This is the only mine in Canada producing anthracite or, more properly, semi-anthracite. The three seams that are being mined are from 6 to 9 feet thick. All sizes of coal from 'broken' to 'buckwheat No. 3' are produced and, as the coal is somewhat fragile, a considerable proportion is briquetted. The briquettes are used on the Canadian Pacific locomotives and for domestic use. The present daily output is 750 tons sized coal and 500 tons briquettes.

Reaching Dunmore junction early in the evening of the 28th, Mr. Coste had the natural gas well lit that the party might enjoy the spectacle of a gas well with a daily

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capacity of 1,500,000 cubic feet and under a pressure of 600 pounds per square inch, burning at night. The gas in this well and in the four other wells in the vicinity was struck at a depth of about 1,000 feet.

The stop at Dunmore ended the technical portion of the trip and Ottawa was reached on the 30th.

During the year 8,903 letters were received, 9,419 sent out, 157,386 maps, parcels, &c., received and 162,308 sent out.

I have the honour to be, Sir,  
Your obedient servant,

JAMES WHITE,  
*Chief Geographer.*

## MAPS PUBLISHED.

Railway map of the Dominion of Canada and Newfoundland, eight sheets: extends from the Atlantic to the Pacific and from Maryland and Oregon on the south to Cumberland sound and Herschell island on the north. Scale, 35 miles to 1 inch. Price, mounted, with rollers, \$3; mounted, without rollers, \$2.50.

Dominion of Canada and Newfoundland, Railway edition, 16 inches by 36 inches. Scale, 100 miles to 1 inch.

Dominion of Canada 'School' map. Scale, 58 miles to 1 inch.

Western Canada, map of portion of Canada west of Lake of the Woods, shows railway systems in distinctive colours. Scale, 35 miles to 1 inch.

Relief map of Canada. Scale, 100 miles to 1 inch.

Resource map of Canada. Scale, 200 miles to 1 inch.

Water-power map, average Rainfall at principal points in Canada. Scale, 100 miles to 1 inch.

Map showing principal Mineral Occurrences in Canada. Scale, 100 miles to 1 inch.

Map showing Forests in Canada. Scale, 200 miles to 1 inch.

Map showing Limits of Principal Forest Trees in Canada. Scale, 100 miles to 1 inch.

Elevator map, shows position and capacity of Elevators in Manitoba, Saskatchewan and Alberta, with tables of Elevator capacities in Canada and Milling capacities in western Canada.

National Transcontinental Railway map, shows route of the National Transcontinental Railway, Moncton to the Pacific. Scale, 100 miles to 1 inch.

Explorations in Northern Canada and adjacent portions of Greenland and Alaska. Scale, 75 miles to 1 inch.

Rocky Mountains (Banff sheet) contoured map of mountains in the vicinity of Banff. Scale, 2 miles to 1 inch.

Rocky Mountains (Lake Louise sheet) contoured map of mountains in the vicinity of Laggan and Field. Scale, 2 miles to 1 inch.

Manitoba, Saskatchewan, Alberta and adjoining portions of Keewatin and British Columbia, four sheets. Scale, 12½ miles to 1 inch.

Index map showing townships in Manitoba, Saskatchewan and Alberta, plans of which have been printed. Scale, 35 miles to 1 inch.

General map of the Northwestern portion of the Dominion of Canada. Edition of 1898. In 2 sheets. Scale, 35 miles to 1 inch.

Map showing Railways in Manitoba, Alberta and Saskatchewan. Scale, 35 miles to 1 inch.

Manitoba—map of province showing Dominion Electoral Divisions. Scale, 12½ miles to 1 inch.

Southern Saskatchewan—map of portion of the province south of latitude 55°. Scale, 12½ miles to 1 inch.

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Southern Alberta—map of portion of the province south of latitude 55°. Scale, 12½ miles to 1 inch.

Northern Alberta—map of portion of the province north of latitude 55°. Scale, 12½ miles to 1 inch.

Regina Land District. Scale, 12½ miles to 1 inch.

Red Deer Land District. Scale, 12½ miles to 1 inch.

Calgary Land District. Scale 12½ miles to 1 inch.

Estevan Land District. Scale, 12½ miles to 1 inch.

Winnipeg Land District. Scale, 12½ miles to 1 inch.

Lethbridge Land District. Scale, 12½ miles to 1 inch.

Edmonton Land District. Scale, 12½ miles to 1 inch.

Dauphin Land District. Scale, 12½ miles to 1 inch.

Yorkton Land District. Scale, 12½ miles to 1 inch.

Prince Albert Land District. Scale, 12½ miles to 1 inch.

Battleford Land District. Scale, 12½ miles to 1 inch.

Moosejaw Land District. Scale, 12½ miles to 1 inch.

Brandon Land District. Scale, 12½ miles to 1 inch.

Peace River District (Northern Alberta)—includes the country between Wetaskiwin and Lake Athabaska, and between Athabaska river and the eastern boundary of British Columbia. Scale, 12½ miles to 1 inch.

Map showing all the Even-numbered sections alienated in Manitoba, Saskatchewan and Alberta, 3 sheets. Scale, 12½ miles to 1 inch.

Odd-section map (Manitoba, Saskatchewan and Alberta)—shows Odd-numbered sections in these provinces that have been alienated as railway land grants, &c. Scale, 12½ miles to 1 inch.

British Columbia 'Railway Belt' map, showing the 'Railway Belt' in British Columbia. Scale, 1/500,000, or 7.89 miles to 1 inch.

Southeastern Alaska and portion of British Columbia. Edition of 1897. Scale, 1/960,000.

Southeastern Alaska and portion of British Columbia. Edition of 1897. Showing award of Alaska Boundary Tribunal, October 20, 1903. Scale, 1/960,000.

Yukon—extends from Lynn canal on the south, to Eagle on the north, and from the Pacific to the Frances river. Scale, 1/750,000 or 11.82 miles to 1 inch.

White, Alsek and Kluane Rivers district, southwestern Yukon. Scale, 1/400,000 or 6.31 miles to 1 inch.

Sheet 1 S.W. Ontario (Windsor sheet)—Essex, Kent and Lambton and portions of Elgin, Middlesex and Huron counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheet 1 S.E. Ontario (London sheet)—Norfolk, Oxford, Brant and portions of Elgin, Middlesex, Huron, Perth, Waterloo and Wentworth counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheets 1 N.W. and 1 N.E. Ontario (Guelph sheet)—Wellington, Grey, Bruce and portions of Huron, Perth, Waterloo, Halton, Dufferin and Simcoe counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheet 2 S.W. Ontario (Hamilton sheet)—Lincoln, Welland, Haldimand and portions of Wentworth and Halton counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheet 2 N.W. and 9 S.W. (part) Ontario (Toronto and Muskoka sheet)—Peel, York, Ontario and Victoria and portions of Halton, Simcoe, Dufferin, Muskoka, Parry Sound, Haliburton, Durham and Peterborough counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheet 2 N.E. Ontario (Belleville sheet)—Northumberland and Prince Edward and portions of Durham, Peterborough, Hastings and Lennox and Addington counties. Scale, 1/250,000, or 3.95 miles to 1 inch.

Sheet 9 N.W. (Timiskaming sheet)—includes the country between Lake Nipissing and the Height-of-Land. Scale, 1/250,000, or 3.95 miles to 1 inch.

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Sheet 11 (Montreal and Quebec sheet)—includes the area between Vaudreuil and the Island of Orleans. Scale, 1 500,000, or 7·89 miles to 1 inch.

Sheet 13—includes whole of New Brunswick, with exception of Madawaska and portions of Westmoreland and Albert counties. Scale, 1/500,000, or 7·89 miles to 1 inch.

Sheet 15—Cape Breton Island and portions of Antigonish and Guysborough counties, N.S. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheet 27, Ontario (Lake of the Woods sheet)—Rainy River district and portions of Thunder Bay district and Keewatin. Scale 1/500,000, or 7·89 miles to 1 inch.

Sheet 28, Ontario (English River sheet)—includes portions of Thunder Bay and Rainy River districts. Scale, 1 500,000, or 7·89 miles to 1 inch.

Sheet 29, Ontario (Lake Nipigon sheet)—includes central portion of Thunder Bay district. Scale, 1 500,000, or 7·89 miles to 1 inch.

## MAPS IN PROGRESS.

Sheet 3 N.W. Ontario (Kingston sheet) includes Leeds and Grenville and portions of Hastings, Addington, Renfrew, Frontenac and Lanark counties. Scale, 1 250,000 or 3·95 miles to 1 inch.

Sheet 5 N.W. Nova Scotia (Halifax sheet) includes portions of Halifax, Hants, Kings and Lunenburg counties. Scale, 1 250,000 or 3·95 miles to 1 inch.

Sheets 5 N.E. and 14 S.E. (part) Nova Scotia (Truro sheet) includes Pictou and portions of Guysboro', Halifax and Colchester counties. Scale, 1/250,000 or 3·95 miles to 1 inch.

Sheet 7 N.E. (Sault Ste. Marie sheet) includes part of Algoma district. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheet 8 N.W. (Sudbury sheet) includes part of Algoma and Nipissing districts. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheet 8 N.E. (Manitoulin sheet) includes portions of Manitoulin, Algoma and Sudbury districts. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheet 9 S.E., Ontario and Quebec (Pembroke sheet) includes portions of Hastings, Addington, Renfrew, Haliburton and Nipissing, Ontario, and of Pontiac county, Quebec. Scale, 1 250,000 or 3·95 miles to 1 inch.

Sheet 10 S.E. (Cornwall sheet) includes Dundas, Prescott and Russell counties, Ontario, and Vaudreuil and Soulanges and portions of Argenteuil and Ottawa counties, Quebec. Scale, 1/250,000, or 3·95 miles to 1 inch.

Sheet 10 S.W., Ontario and Quebec (Ottawa sheet) includes portions of Carleton, Lanark, Frontenac and Renfrew counties, Ontario, and of Ottawa and Pontiac counties, Quebec. Scale, 1/250,000, or 3·95 miles to 1 inch.

Sheet 14 S.W. (Moncton sheet) includes portions of Colchester and Cumberland counties, N.S., Albert, Westmoreland and Kent, N.B., and Prince, P.E.I. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheets 14 N.W., 14 S.W. and 14 S.E. (parts) Prince Edward Island sheet—includes the island and mainland in vicinity. Scale, 1 250,000, or 3·95 miles to 1 inch.

Sheet 30, Ontario (White River sheet) includes portions of Algoma and Thunder Bay districts. Scale, 1 500,000, or 7·89 miles to 1 inch.

Sheet 31, Ontario (Abitibi sheet) includes portions of Algoma and Nipissing districts. Scale, 1 500,000, or 7·89 miles to 1 inch.

Sheet 31 S.E. (Lake Abitibi sheet) includes the surveyed townships in vicinity of Lake Abitibi, Nipissing and Algoma districts. Scale, 1/250,000, or 3·95 miles to 1 inch.

Sheet 41, British Columbia (Prince Rupert sheet) includes portions of the province between longitude 128° W. and 131° W., and between latitude 52° N. and 55° N. Scale, 1/500,000, or 7·89 miles to 1 inch.

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Sheet 42, British Columbia (Babine Lake sheet) includes portion of the province between longitude  $125^{\circ}$  W. and  $128^{\circ}$  W., and between latitude  $52^{\circ}$  N. and  $55^{\circ}$  N. Scale, 1/500,000, or 7.89 miles to 1 inch.

Sheet 43, British Columbia (Fort George sheet) includes portion of the province between longitude  $122^{\circ}$  W. and  $125^{\circ}$  W., and between latitude  $52^{\circ}$  N. and  $55^{\circ}$  N. Scale, 1/500,000, or 7.89 miles to 1 inch.

Sheet 44, British Columbia (Tete Jaune Cache sheet) includes portions of the province between longitude  $119^{\circ}$  W. and  $122^{\circ}$  W., and between latitude  $52^{\circ}$  N. and  $55^{\circ}$  N. Scale, 1/500,000, or 7.89 miles to 1 inch.

Sheet 45, British Columbia (Jasper House sheet) includes portions of the province between longitude  $116^{\circ}$  W. and  $119^{\circ}$  W., and between latitude  $52^{\circ}$  N. and  $55^{\circ}$  N. Scale, 1/500,000, or 7.89 miles to 1 inch.

Peace River Land District map. Scale,  $12\frac{1}{2}$  miles to 1 inch.

Saskatoon Land District map. Scale,  $12\frac{1}{2}$  miles to 1 inch.

Rocky Mountains between the Canadian Pacific Railway and the North Saskatchewan. Scale, 4 miles to 1 inch.

Atlas of Canada, 1906. (Out of print.)

## ATLAS OF CANADA MAPS.

1. Territorial divisions.
2. Relief map, west sheet.
3. Relief map, east sheet.
4. Geology, west sheet.
5. Geology, east sheet.
6. Minerals, west sheet.
7. Minerals, east sheet.
8. Forests.
9. Limits of trees.
10. Telegraphs—Quebec and Maritime Provinces.
11. Telegraphs—Ontario and Quebec.
12. Telegraphs—Manitoba, Saskatchewan and Alberta.
13. Telegraphs—British Columbia, Yukon and Alberta.
14. Telephones—Maritime Provinces and Quebec.
15. Telephones—Ontario and Quebec.
16. Telephones—Manitoba, Saskatchewan, Alberta, British Columbia.
17. Railways—Quebec and Maritime Provinces.
18. Railways—Ontario and Quebec.
19. Railways, Manitoba, Saskatchewan and Alberta.
20. Railways—British Columbia, Alberta and Yukon.
21. Transcontinental railways.
22. Canals, lighthouses and sailing routes—St. Lawrence and Great Lakes.
23. Lighthouses and sailing routes—Pacific coast.
24. Lighthouses and sailing routes—Atlantic coast.
25. Isotherms for months of year.
26. Isotherms for summer and year; precipitation, snowfall and isobars.
- 26*a*. Average possible hours of sunshine in summer months and temperature maps.
27. Density of population—Maritime Provinces and Quebec.
- 27*a*. Density of population—Ontario and Quebec.
28. Density of population—Manitoba and Saskatchewan.
- 28*a*. Density of population—British Columbia and Alberta.
29. Aborigines of Canada—Alaska and Greenland.
- 29*a*. Origins of the people—Maritime provinces and Quebec.
- 29*b*. Origins of the people—Ontario and Quebec.

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- 29c. Origins of the people—Manitoba and Saskatchewan.
- 29d. Origins of the people—British Columbia and Alberta.
- 30. International and interprovincial boundaries (a) Eastern Canada-United States; (b) New Brunswick-Quebec; (c) Quebec-Labrador.
- 31. Interprovincial boundary—Ontario-Manitoba.
- 31a. International boundary—British Columbia and Yukon-Alaska.
- 32. Routes of explorers.
- 32. Drainage basins.
- 34. Montreal.
- 35. Toronto.
- 36. Quebec, St. John.
- 37. Winnipeg.
- 38. Vancouver, Ottawa.
- 39. Hamilton, London, Halifax.

## DIAGRAMS.

- 40. Trade and Commerce—Exports.
- 41. Trade and Commerce—Imports.
- 42. Trade and Commerce—Exports, principal items.
- 43. Trade and Commerce—Imports, principal items.
- 44. Trade and Commerce—Imports per head, duty, increase of trade.
- 45. Minerals, telegraphs.
- 46. Population according to (a) age and sex; (b) sex and conjugal condition.
- 47. Population according to age, sex and conjugal condition.
- 48. Population (a) proportion of British and foreign born; (b) birthplace of native population; (c) areas of provinces and territories.
- 49. Population (a) origins, (b) religions; (c) birthplaces.
- 50. Population (a) interprovincial immigration; (b) proportion of population; (c) density of population; (d) rural and urban.
- 51. Population, from earliest records to 1901, in Ontario, Manitoba, British Columbia, Alberta, Saskatchewan, other territories.
- 52. Population from earliest records to 1901, in Quebec, Nova Scotia, New Brunswick, Prince Edward Island.
- 53. Population—Cities and towns with a population of upwards of 7,000
- 54. Population—Cities and towns with a population of upwards of 7,000.
- 55. Population—Cities and towns with a population of upwards of 7,000.
- 56. Agriculture—Value of land, &c.; of farm products; number of farmers and classification of farm area.
- 57. Agriculture—Improved and unimproved area; value of farm property.
- 58. Agriculture—Size of farms; number of farms; value of agricultural products.
- 59. Agriculture—Number of (a) sheep, (b) horses, (c) cattle.
- 60. Agriculture—Value of crops, live stock, dairy produce, &c.
- 61. Agriculture—Production of grains, &c.
- 62. Agriculture—Principal crops of Ontario.
- 63. Agriculture—Principal crops of Manitoba.
- 64. Manufactures—Capital invested, number of wage-earners, value of products.
- 65. Manufactures—Proportion of population, value of produce by provinces.
- 66. Vital statistics—(a) blind, (b) deaths.
- 67. Vital statistics—(a) insane, (b) deaf and dumb.
- 68. Finance—Revenue.
- 69. Finance—Expenditure.
- 70. Finance—Debt, expenditure for public works; assets.

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71. Currency and banking—Savings banks, deposits and withdrawals.
72. Currency and banking—Chartered banks, liabilities, assets, deposits, loan and reserve fund.
73. Currency and banking—Chartered banks, capital, deposits, liabilities and assets.
74. Marine—Light stations, &c., vessels entered, 1903.
75. Marine—Vessels arrived and departed, coasting vessels.
76. Marine—Sea-going shipping, vessels on inland waters.
77. Marine—Vessels in coasting trade, by provinces.
78. Fisheries—Yield, fishermen, value of vessels, &c., fish exports.
79. Railways—Capital, passengers, freight, mileage.
80. Railways—Earnings, working expenses, receipts, expenditure.
81. Railways—Train mileage, rolling stock, passengers, freight.
82. Government railways—Expenditure and revenue, earnings and operating expenses, receipts.
83. Education, immigration—Literate and illiterate, schools, teachers, pupils, expenditure, number of immigrants.

## REPORTS.

Altitudes in the Dominion of Canada. With a relief map of North America, 8vo., pp. 226.

Dictionary of altitudes in the Dominion of Canada. With a relief map of Canada, 8vo., pp. 143.

Altitudes in the Dominion of Canada, 2nd edition (in progress).

## No. 35.

## REPORT OF THE SCHOOL LANDS BRANCH.

DEPARTMENT OF THE INTERIOR.

SCHOOL LANDS BRANCH,

OTTAWA, June 15, 1909.

W. W. CORY, Esq.,

Deputy Minister of the Interior.

Ottawa.

SIR,—I have the honour to submit the following report on the business of the School Lands Branch of the department for the fiscal year ending March 31, 1909.

## SALES.

In view of the comparatively poor harvest of the year 1907, and of the financial stringency then prevailing, it was not considered advisable to hold any general auction sales of school lands in the provinces of Manitoba, Saskatchewan and Alberta during the past fiscal year.

At the instance, however, of the government of Alberta, section 29, township 42, range 25 west of the fourth meridian was offered for sale at Ponoka, Alberta, in order to afford them an opportunity of acquiring it in connection with an insane asylum to be erected at that point. The sale was held on April 7, 1908, and the land was sold at \$12 per acre to Mr. L. C. Charlesworth as representing the Minister of Public Works for Alberta.

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An auction sale was also held at Chaplin, Saskatchewan, on November 5, 1908, of the lots in the subdivision of a portion of section 29, township 17, range 5, west of the third meridian, fifty-four lots being disposed of for \$771.

In regard to this I may say that it was found necessary to sub-divide a portion of this section into town lots for the reason that a number of persons had settled on the section and had erected buildings thereon, and it was, therefore, considered advisable to have the land surveyed and subdivided so as to afford those who had made improvements an opportunity of acquiring the lots on which their buildings are situated.

A number of parcels comprising from one to five acres each were also sold during the past fiscal year for school and cemetery purposes. The lands required for school purposes were sold under the amendment to the Dominion Lands Act which provides that portions of school sections required for school sites, not exceeding four acres, may be sold to boards of school trustees at the minimum price of \$10 per acre, provided the application of the trustees is endorsed by the minister or deputy minister of education for the province, and that the parcel selected fronts on a road allowance.

Some forty-three sales were also made to railway companies under the Railway Act, of the lands required in school sections for right of way, station grounds, ballast pit, &c., comprising in all some 350.76 acres, representing the sum of \$6,754.86.

The net revenue from payments on sales during the past fiscal year was as follows :—

|                       |              |
|-----------------------|--------------|
| Manitoba. . . . .     | \$360,999 16 |
| Saskatchewan. . . . . | 160,395 91   |
| Alberta. . . . .      | 128,301 46   |
|                       | <hr/>        |
| Total. . . . .        | \$649,696 53 |
|                       | <hr/>        |

## LEASES.

A radical change was made during the year in the manner of renting school lands for grazing purposes.

Heretofore leases have been issued for grazing purposes covering a period of five years subject to a rental of six cents per acre for the school lands in Manitoba, and four cents for those in Saskatchewan and Alberta.

Great difficulty was, however, found in collecting the rental under these leases, the lessees in many instances paying no attention to the notices sent them. The accounts were then placed in the hands of an inspector for collection, but in many cases they were unable to obtain the rental, the lessees either being away from home or not having the money at the time, and as these leases seldom cover more than one section, the amount owing is so inconsiderable that it would hardly be worth while collecting the amount due by process of law, and it is consequently in such cases lost to the fund.

Under these circumstances it was decided that it would be in the interest of the school lands endowment fund to discontinue the issue of grazing leases of school lands, and to substitute for the leases grazing permits. Provision for this was made by order in council of February 22, 1908.

These permits only cover one year, expiring on the 1st of April next following their issue, but they are renewable from year to year at the option of the department, provided that application for the renewal is made each year on or before the 1st February, accompanied by the rental for the next year. Should the permittee not renew his application by the time mentioned, the department is then at liberty to grant the permit to the next applicant after its expiration on the 1st April.

A great saving of time and labour is effected by the change, as no book-keeping is necessary in connection with the permits, and a large amount of correspondence is



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also saved. There can, of course, be no arrears as the permit is not issued until rental is paid for the current year, and it is not renewed again until the rental for the next year is paid.

During the past fiscal year prior to the issue of the grazing permits 160 grazing leases were issued. Since then 291 grazing permits have been issued.

The net revenue from grazing leases and permits for the fiscal year was as follows :—

|                   |             |
|-------------------|-------------|
| Manitoba.....     | \$ 1,125 67 |
| Saskatchewan..... | 9,103 89    |
| Alberta.....      | 9,552 41    |

Nine coal leases were issued during the fiscal year, and the revenue from this source was as follows :—

|                   |           |
|-------------------|-----------|
| Manitoba.....     | Nil.      |
| Saskatchewan..... | \$ 981 11 |
| Alberta.....      | 3,160 81  |

Hereto attached are three statements lettered A, B and C, respectively, showing the revenue from all sources collected from school lands in Manitoba, Saskatchewan and Alberta during the fiscal year. From this it will be seen that the total net revenue for that period was as follows :—

|                   |                     |
|-------------------|---------------------|
| Manitoba.....     | \$365,430 16        |
| Saskatchewan..... | 172,754 90          |
| Alberta.....      | 143,440 40          |
| Total.....        | <u>\$681,625 46</u> |

Statement D shows the revenue collected through the Dominion lands agencies.

Of the total net revenue of \$681,625.46, the sum of \$38,639.59 was collected through the Dominion lands agencies, and the balance of \$642,985.87 at head office.

The expenditure for the fiscal year was as follows :—

|                   |                    |
|-------------------|--------------------|
| Manitoba.....     | \$ 6,872 13        |
| Saskatchewan..... | 6,947 00           |
| Alberta.....      | 6,840 60           |
| Total.....        | <u>\$20,659 73</u> |

As the net revenue for the fiscal year was \$681,625.46, the expenditure was as nearly as possible 3 per cent of the revenue, which, I submit, is a very moderate amount for the administration of the school lands in the three provinces.

Statements E, F and G are hereto attached showing the revenue and expenditure on account of the school lands fund for the fiscal year, and also the balance standing to the credit of each of the school lands funds on March 31, 1909. From this it will be seen that the balance to the credit of the Manitoba School Lands Fund on March 31 was \$2,185,211.69; the Saskatchewan School Lands Fund, \$850,398.41, and the Alberta School Lands Fund, \$452,123.39.

In accordance with orders in council in that regard, cheques were issued in favour of the provincial treasurer of each of the provinces of Manitoba, Saskatchewan and Alberta covering the revenue collected from school lands during the last fiscal year other than principal moneys of sales after deducting the cost of management. The amount so paid over to each province was as follows :—

|                   |              |
|-------------------|--------------|
| Manitoba.....     | \$108,895 41 |
| Saskatchewan..... | 52,113 24    |
| Alberta.....      | 54,239 84    |

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There is a slight decrease in the gross revenue for the enrrent year as compared with the previous year, namely, \$688,466.51, as against \$704,963.33.

This is due to the fact that there were no general auction sales held during the past fiscal year. The work of the branch has, however, greatly increased in other respects.

I may say that prior to the close of the fiscal year steps were taken for the inspection and valuation of a large number of school lands in Manitoba and Alberta with a view to holding auction sales in these provinces during the present year, and from present indications it is likely that the sales will be very successful.

The following is a statement of the clerical work of the branch for the past fiscal year:—

|  |        |
|--|--------|
| Letters received and registered. . . . .   | 10,042 |
| Letters and telegrams sent. . . . .        | 16,045 |
| Leases and grazing permits issued. . . . . | 460    |
| Cultivation permits issued. . . . .        | 30     |
| Receipts issued. . . . .                   | 2,970  |
| Accounts. . . . .                          | 6,178  |
| Assignments registered. . . . .            | 205    |

Respectfully submitted,

FRANK S. CHECKLEY,  
*Chief of Branch.*

A.—MANITOBA SCHOOL LANDS.  
 STATEMENT of Revenue collected from School Lands for the Fiscal Year, from April 1, 1908, to March 31, 1909,  
 both dates inclusive.

| Month.  | SALES.     |            | Total.     | Cultivation Permits. |          | Grazing. | Timber.  |      | Hay. | Registration Fees. |        | Total.     |
|---|------------|------------|------------|----------------------|----------|----------|----------|------|------|--------------------|--------|------------|
|   | Principal. | Interest.  |            | \$                   | cts.     |          | \$       | cts. |      | \$                 | cts.   |            |
| 1908.   |            |            |            |                      |          |          |          |      |      |                    |        |            |
| April.....  | 1,843 68   | 2,242 00   | 4,085 68   | 5 50                 | 62 07    | 40 00    |          |      |      |                    |        | 4,143 25   |
| May.....  | 4,353 82   | 4,302 65   | 8,656 47   | 10 00                | 51 20    |          |          |      |      |                    |        | 8,717 67   |
| June.....   | 17,217 42  | 11,798 93  | 29,016 35  | 4 00                 | 113 42   | 3 00     |          |      |      |                    |        | 29,136 77  |
| July.....   | 11,650 55  | 7,421 63   | 13,072 18  |                      | 112 50   |          | 125 00   |      |      |                    |        | 19,390 68  |
| August.....   | 2,610 96   | 1,216 41   | 3,827 37   |                      | 13 92    |          |          |      |      |                    |        | 3,841 29   |
| September.....  | 957 76     | 918 46     | 1,876 22   |                      | 28 85    |          |          |      |      |                    |        | 1,905 07   |
| October.....  | 30,895 34  | 10,225 60  | 41,120 94  | 5 50                 | 59 10    | 33 00    |          |      |      |                    |        | 41,218 54  |
| November.....   | 95,261 12  | 33,611 31  | 128,872 43 | 50 00                | 48 00    |          |          |      |      |                    |        | 128,970 43 |
| December.....   | 40,269 35  | 20,447 72  | 60,717 07  | 6 00                 | 28 80    |          |          |      |      |                    |        | 60,751 87  |
| 1909.   |            |            |            |                      |          |          |          |      |      |                    |        |            |
| January.....  | 2,513 58   | 6,442 06   | 26,955 64  | 73 80                | 111 25   |          |          |      |      |                    |        | 27,140 69  |
| February.....   | 8,955 45   | 3,236 45   | 12,191 90  | 25 50                | 8 21     |          | 6 55     |      |      |                    |        | 12,232 16  |
| March.....  | 3,765 85   | 5,812 21   | 15,578 06  | 18 50                | 54 69    |          |          |      |      |                    |        | 15,651 16  |
| Total.....  | 244,294 88 | 107,075 43 | 351,970 31 | 198 80               | 631 92   | 43 00    | 164 55   |      |      |                    |        | 353,068 38 |
| Agencies.....   | 5,775 27   | 3,567 16   | 9,443 43   | 12 50                | 591 75   | 1,254 48 | 1,850 35 |      |      |                    |        | 13,152 51  |
| Registration fees.....  | 250,071 15 | 111,342 59 | 361,413 74 | 211 30               | 1,283 67 | 1,297 48 | 2,014 90 |      |      |                    | 204 50 | 365,221 09 |
| Transfer of fees to Dominion Lands.....                         | 250,071 15 | 111,342 59 | 361,413 74 | 211 30               | 1,283 67 | 1,297 48 | 2,014 90 |      |      |                    | 204 50 | 365,425 39 |
| Amt. Dep. C.N.R. per bank receipt No. 420 of Nov. 26, 1908..... | 250,071 15 | 111,342 59 | 361,413 74 | 211 30               | 1,283 67 | 1,297 48 | 2,014 90 |      |      |                    | 204 50 | 365,094 09 |
| Re-funds.....   | 498 91     | 6 05       | 504 96     |                      | 158 00   | 14 35    | 77 00    |      |      |                    |        | 664 31     |
|   | 249,662 62 | 111,336 54 | 360,999 16 | 211 30               | 1,125 67 | 1,014 13 | 1,875 40 |      |      |                    | 204 50 | 365,430 16 |

DEPARTMENT OF THE INTERIOR,  
 SCHOOL LANDS BRANCH,  
 OTTAWA, June 10, 1909.  
 FRANK S. CHECKLEY,  
 Chief of Branch.

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B.—SASKATCHEWAN SCHOOL LANDS.

STATEMENT of Revenue collected from School Lands for the Fiscal Year from April 1, 1908, to March 31, 1909, both dates inclusive.

| Month.                               | SALES.     |           | Total.  | Cultiva-<br>tion<br>Permits. | Grazing<br>Permits. | Timber. | Hay.  | Coal. | Sand. | Registra-<br>tion<br>Fees. | Total.  |    |
|--------------------------------------|------------|-----------|---------|------------------------------|---------------------|---------|-------|-------|-------|----------------------------|---------|----|
|                                      | Principal. | Interest. |         |                              |                     |         |       |       |       |                            |         |    |
|                                      | \$         | cts.      | \$      | \$                           | cts.                | \$      | cts.  | \$    | cts.  | \$                         | cts.    |    |
| 1908.                                |            |           |         |                              |                     |         |       |       |       |                            |         |    |
| April.....                           | 9,740      | 22        | 11,215  | 19                           | 483                 | 45      | 40    | 00    | ..... | .....                      | 11,750  | 64 |
| May.....                             | 3,129      | 58        | 4,081   | 14                           | 392                 | 28      | 8     | 50    | 498   | 57                         | 4,990   | 99 |
| June.....                            | 4,349      | 20        | 5,814   | 05                           | 736                 | 32      | ..... | ..... | ..... | .....                      | 6,577   | 49 |
| July.....                            | 1,969      | 78        | 2,421   | 92                           | 427                 | 05      | 16    | 00    | ..... | .....                      | 2,864   | 97 |
| August.....                          | 2,139      | 78        | 2,770   | 12                           | 525                 | 98      | ..... | ..... | ..... | .....                      | 3,296   | 05 |
| September.....                       | 1,335      | 16        | 1,801   | 73                           | 187                 | 14      | ..... | ..... | ..... | .....                      | 2,004   | 37 |
| October.....                         | 15,971     | 27        | 20,927  | 77                           | 528                 | 05      | 1     | 00    | 240   | 59                         | 21,520  | 32 |
| November.....                        | 33,236     | 35        | 47,685  | 61                           | 172                 | 51      | ..... | ..... | ..... | .....                      | 48,058  | 74 |
| December.....                        | 12,876     | 09        | 23,331  | 22                           | 228                 | 80      | ..... | ..... | ..... | .....                      | 23,560  | 02 |
| 1909.                                |            |           |         |                              |                     |         |       |       |       |                            |         |    |
| January.....                         | 10,756     | 73        | 14,529  | 47                           | 277                 | 35      | ..... | ..... | ..... | .....                      | 14,806  | 82 |
| February.....                        | 6,508      | 97        | 8,500   | 35                           | 800                 | 20      | 2     | 00    | ..... | .....                      | 9,308   | 05 |
| March.....                           | 10,556     | 00        | 13,379  | 74                           | 782                 | 97      | ..... | ..... | ..... | .....                      | 14,172  | 71 |
| Total.....                           | 111,968    | 85        | 156,521 | 31                           | 5,536               | 08      | 67    | 50    | 739   | 16                         | 163,041 | 17 |
| Agencies.....                        | 1,765      | 32        | 3,914   | 09                           | 3,655               | 65      | 2,361 | 70    | 241   | 95                         | 10,345  | 29 |
| Registration fees.....               | 113,734    | 15        | 166,135 | 40                           | 9,191               | 73      | 2,429 | 26    | 981   | 11                         | 173,386 | 46 |
| Transfer fees to Dominion Lands..... | 113,734    | 15        | 160,435 | 40                           | 9,191               | 73      | 2,429 | 26    | 981   | 11                         | 173,481 | 96 |
| Refunds.....                         | 39         | 49        | 39      | 49                           | 87                  | 84      | 89    | 23    | ..... | .....                      | 465     | 00 |
|                                      | 113,694    | 66        | 160,395 | 91                           | 9,103               | 89      | 1,856 | 97    | 981   | 11                         | 172,754 | 99 |

FRANK S. CHECKLEY,  
Chief of Branch.

DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.

## SESSIONAL PAPER No. 25

## C.—ALBERTA SCHOOL LANDS.

STATEMENT of Revenue collected from School Lands for the Fiscal Year from April 1, 1908, to March 31, 1909, both dates inclusive.

| Months.                         | SALES.     |           | Total.     | Cultivation Permits. | Grazing Permits. | Timber.  | Hay.     | Coal.    | Registration Fees. | Total.     |
|---------------------------------|------------|-----------|------------|----------------------|------------------|----------|----------|----------|--------------------|------------|
|                                 | Interest.  |           |            |                      |                  |          |          |          |                    |            |
|                                 | Principal. | Interest. |            |                      |                  |          |          |          |                    |            |
|                                 | \$         | cts.      | \$         | cts.                 | \$               | cts.     | \$       | cts.     | \$                 | cts.       |
| 1908.                           |            |           |            |                      |                  |          |          |          |                    |            |
| April                           | 1,155 57   | 882 53    | 2,038 10   |                      | 401 10           |          |          | 216 00   |                    | 2,655 26   |
| May                             | 602 35     | 484 30    | 1,086 65   |                      | 283 07           |          |          | 132 00   |                    | 1,451 72   |
| June                            | 1,166 38   | 1,130 53  | 2,296 91   |                      | 563 95           |          |          | 229 00   |                    | 3,080 86   |
| July                            | 2,443 50   | 1,482 51  | 3,876 01   |                      | 340 00           |          |          | 226 30   |                    | 4,442 31   |
| August                          | 2,774 26   | 703 49    | 3,477 75   |                      | 464 45           | 12 25    |          | 58 00    |                    | 4,012 45   |
| September                       | 1,750 98   | 1,162 21  | 2,883 19   |                      | 159 75           | 30 00    |          | 192 00   |                    | 3,264 94   |
| October                         | 9,647 56   | 3,653 35  | 13,290 91  |                      | 213 96           |          |          | 53 00    |                    | 13,507 47  |
| November                        | 29,879 46  | 19,709 28 | 49,588 74  |                      | 370 87           |          |          | 168 15   |                    | 50,127 76  |
| December                        | 14,113 07  | 8,190 68  | 22,303 75  | 3 25                 | 205 00           |          |          | 192 00   |                    | 22,704 00  |
| 1909.                           |            |           |            |                      |                  |          |          |          |                    |            |
| January                         | 7,786 82   | 2,574 11  | 10,360 93  |                      | 488 33           |          |          | 170 00   |                    | 11,019 26  |
| February                        | 4,626 99   | 2,042 06  | 6,669 05   |                      | 657 88           |          |          | 84 00    |                    | 7,410 93   |
| March                           | 5,701 77   | 2,131 61  | 7,833 38   | 13 80                | 704 13           |          |          | 985 90   |                    | 9,537 21   |
| Total                           | 81,618 71  | 44,046 66 | 125,665 37 | 17 05                | 4,852 15         | 42 25    | 1,091 80 | 2,697 35 |                    | 133,274 17 |
| Agencies                        | 4,910 83   | 1,894 84  | 6,805 67   |                      | 4,752 59         | 1,358 27 |          | 1,133 46 |                    | 15,141 79  |
| Registration fees               | 86,529 54  | 45,941 50 | 132,471 04 | 17 05                | 9,604 74         | 1,400 52 | 1,091 80 | 3,830 81 | 143 00             | 148,415 96 |
| Transfer fees to Dominion Lands | 86,529 54  | 45,941 50 | 132,471 04 | 17 05                | 9,604 74         | 1,400 52 | 1,091 80 | 3,830 81 | 143 00             | 148,558 96 |
| Refunds                         | 86,529 54  | 45,941 50 | 132,471 04 | 17 05                | 9,604 74         | 1,374 37 | 9 00     | 3,830 81 | 143 00             | 148,341 31 |
|                                 | 4,169 58   |           | 4,169 58   |                      | 52 33            |          |          | 670 00   |                    | 4,900 91   |
|                                 | 82,359 96  | 45,941 50 | 128,301 46 | 17 05                | 9,552 41         | 1,374 37 | 891 30   | 3,160 81 | 143 00             | 143,440 40 |

DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.

FRANK S. CHECKLEY,  
Chief of Branch.

9-10 EDWARD VII., A. 1910

D.—SCHOOL Lands Revenue, collected through Dominion Lands Agencies, during the Fiscal Year ending March 31, 1909.

| Agencies        | SALES.     |          | Total.    | Cultivation. | Grazing  | Timber.  | Hay.     | Coal.    | Sand.  | Total.    |
|-----------------|------------|----------|-----------|--------------|----------|----------|----------|----------|--------|-----------|
|                 | Principal. | Interest |           |              |          |          |          |          |        |           |
|                 | § cts.     | § cts.   | § cts.    | § cts.       | § cts.   | § cts.   | § cts.   | § cts.   | § cts. | § cts.    |
| Winnipeg.....   | 1,884 70   | 1,714 23 | 3,598 93  | 12 50        | 135 80   | 1,641 35 | 844 38   |          |        | 6,232 96  |
| Brandon.....    | 3,639 24   | 1,700 04 | 5,339 28  |              | 461 21   | 6 50     | 274 70   |          |        | 6,081 69  |
| Dauphin.....    | 252 33     | 252 89   | 505 22    |              | 177 80   | 202 50   | 243 20   |          |        | 1,128 72  |
| Estevan.....    |            | 50 40    | 50 40     |              | 475 20   |          | 390 20   | 226 95   |        | 1,142 75  |
| Regina.....     | 1,255 67   | 885 10   | 2,140 77  |              | 781 71   | 87 00    | 556 10   |          | 28 15  | 3,593 73  |
| Yorkton.....    | 509 65     | 1,213 27 | 1,722 92  |              | 204 80   |          | 279 30   |          |        | 2,207 02  |
| Prince Albert.. |            |          |           | 10 00        | 411 95   | 39 00    | 396 90   |          |        | 857 85    |
| Battleford..... |            |          |           |              | 383 62   | 5 00     | 192 80   | 10 00    |        | 591 42    |
| Humboldt.....   |            |          |           |              | 563 82   | 25       | 184 80   |          |        | 748 87    |
| Moosejaw.....   |            |          |           |              | 651 49   | 2 50     | 253 80   | 5 00     |        | 912 79    |
| Lethbridge..... |            |          |           |              | 2,289 01 | 43 94    | 69 60    | 532 61   |        | 2,935 16  |
| Calgary.....    | 3,022 83   | 1,836 84 | 4,859 67  |              | 1,711 28 |          | 301 10   | 96 00    |        | 6,968 05  |
| Red Deer.....   | 1,888 00   | 58 00    | 1,926 00  |              | 452 38   | 17 00    | 289 55   | 287 25   |        | 2,992 18  |
| Edmonton.....   |            |          |           |              | 299 92   | 1,297 33 | 431 55   | 217 60   |        | 2,246 40  |
|                 | 12,452 42  | 7,710 77 | 20,163 19 | 22 50        | 8,999 99 | 3,342 37 | 4,707 98 | 1,375 41 | 28 15  | 38,639 59 |

FRANK S. CHECKLEY,  
*Chief of Branch.*

DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.

SESSIONAL PAPER No. 25

## E.—MANITOBA SCHOOL LANDS.

STATEMENT of Revenue and Expenditure on account of Manitoba School Lands for the Fiscal Year ended March 31, 1909.

| Particulars.  | Period.                           | Dr.       |      | Cr.       |      |
|---|-----------------------------------|-----------|------|-----------|------|
|   |                                   | \$        | cts. | \$        | cts. |
| By balance on April 1, 1908. ....   |                                   |           |      | 1,935,791 | 84   |
| " sales. ....   | 12 months .....                   |           |      | 360,999   | 16   |
| " cultivation permits .....   | " .....                           |           |      | 211       | 30   |
| " timber dues, hay permits and grazing<br>rentals .....                                     | March 31, 1909. ....              |           |      | 4,015     | 20   |
| " registration fees .....   |                                   |           |      | 204       | 50   |
| " interest on fund .....  | 12 months to March 31, 1909. .... |           |      | 62,161    | 11   |
| To cost of management at Ottawa .....   | " .....                           | 3,226     | 30   |           |      |
| " salaries, printing, advertising and gen-<br>eral expenses. ....                           | " .....                           | 3,645     | 83   |           |      |
| " amount over-credited on account of<br>interest during period ended June<br>30, 1907. .... |                                   |           |      | 242       | 77   |
| " revenue and interest paid to the Mani-<br>toba Government. ....                           | 12 months to March 31, 1909. .... | 108,895   | 41   |           |      |
| " interest on fund paid to the Manitoba<br>Government. ....                                 | " .....                           | 62,161    | 11   |           |      |
| " balance on March 31, 1909. ....   |                                   | 2,185,211 | 69   |           |      |
|   |                                   | 2,363,383 | 11   | 2,363,383 | 11   |

FRANK S. CHECKLEY,  
*Chief of Branch.*DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.

9-10 EDWARD VII., A. 1910

## F.—SASKATCHEWAN SCHOOL LANDS.

STATEMENT of Revenue and Expenditure on account of Saskatchewan School Lands  
for the Fiscal Year ended March 31, 1909.

| Particulars.   | Period.                          | Dr.     |      | Cr.     |           |
|--|----------------------------------|---------|------|---------|-----------|
|  |                                  | \$      | cts. | \$      | cts.      |
| By balance on April 1, 1908.....                                 |                                  |         |      | 736,703 | 75        |
| " sales.....   | 12 months to March 31, 1909..... |         |      | 160,395 | 91        |
| " cultivation permits.....                                       | " ".....                         |         |      |         | 171 62    |
| " timber dues, hay permits, grazing,<br>coal, &c.....            | " ".....                         |         |      | 12,091  | 87        |
| " registration fees.....   | " ".....                         |         |      |         | 95 50     |
| " interest on fund.....  | " ".....                         |         |      |         | 24,289 14 |
| To cost of management at Ottawa.....                             | " ".....                         | 3,226   | 29   |         |           |
| " salaries, printing, advertising and<br>general expenses.....   | " ".....                         | 3,720   | 71   |         |           |
| " revenue and interest paid to Sas-<br>katchewan Government..... | " ".....                         | 52,113  | 24   |         |           |
| " interest on fund paid to Saskatchewan<br>Government.....       | " ".....                         | 24,289  | 14   |         |           |
| " Balance on March 31, 1909.....                                 | " ".....                         | 850,398 | 41   |         |           |
|  |                                  | 933,747 | 79   | 933,747 | 79        |

FRANK S. CHECKLEY,  
*Chief of Branch.*DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.

## G.—ALBERTA SCHOOL LANDS.

STATEMENT of Revenue and Expenditure on account of Alberta School Lands for  
the Fiscal Year ended March 31, 1909.

| Particulars.   | Period.                             | Dr.     |      | Cr.     |           |
|--|-------------------------------------|---------|------|---------|-----------|
|  |                                     | \$      | cts. | \$      | cts.      |
| By balance on April 1, 1908.....                               |                                     |         |      | 369,763 | 43        |
| " sales.....   | 12 months ended March 31, 1909..... |         |      | 128,301 | 46        |
| " cultivation permits.....                                     | " ".....                            |         |      |         | 17 05     |
| " timber dues, hay permits, grazing<br>and coal.....           | " ".....                            |         |      | 14,978  | 89        |
| " registration fees.....                                       | " ".....                            |         |      |         | 143 00    |
| " interest on fund.....  | " ".....                            |         |      |         | 12,790 69 |
| To cost of management at Ottawa.....                           | " ".....                            | 3,226   | 29   |         |           |
| " salaries, printing, advertising and<br>general expenses..... | " ".....                            | 3,614   | 31   |         |           |
| " revenue and interest paid to Alberta<br>Government.....      | " ".....                            | 54,239  | 84   |         |           |
| " interest on fund paid to Alberta<br>Government.....          | " ".....                            | 12,790  | 09   |         |           |
| " Balance on March 31, 1909.....                               | " ".....                            | 452,123 | 39   |         |           |
|  |                                     | 525,993 | 92   | 525,993 | 92        |

FRANK S. CHECKLEY,  
*Chief of Branch.*DEPARTMENT OF THE INTERIOR,  
SCHOOL LANDS BRANCH,  
OTTAWA, June 10, 1909.



PART II  
IMMIGRATION



# IMMIGRATION

## REPORT OF THE SUPERINTENDENT OF IMMIGRATION.

DEPARTMENT OF THE INTERIOR,

OTTAWA, May 3, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit herewith the annual reports of the principal officers engaged in the immigration service in Canada and abroad, having reference to the fiscal year ending March 31, 1909, and at the same time to draw attention to the following statistical tables compiled in my office:—

### IMMIGRANT ARRIVALS.

SUMMARY for the fiscal Year 1908-9.

|                                      |       |        |         |
|--------------------------------------|-------|--------|---------|
| Per ocean travel—                    |       |        |         |
| Quebec.....                          |       | 44,070 |         |
| St. John.....                        |       | 13,601 |         |
| Halifax.....                         |       | 13,379 |         |
| North Sydney.....                    |       | 2,390  |         |
| Vancouver.....                       |       | 1,517  |         |
| Victoria.....                        |       | 1,302  |         |
| New York.....                        | 8,458 |        |         |
| Portland.....                        | 1,615 |        |         |
| Boston.....                          | 675   |        |         |
| Philadelphia.....                    | 40    |        |         |
| Baltimore.....                       | 29    | 10,817 | 87,076  |
| From the United States (direct)..... |       |        | 59,832  |
| Total.....                           |       |        | 146,908 |

### COMPARATIVE STATEMENT.

TOTAL Immigrants arriving for Canada by months, for the fiscal year ending March 31, 1909, and for the fiscal year ending March 31, 1908.

|                | FISCAL YEAR 1907-8. |          |           |         | FISCAL YEAR 1908-9. |          |           |         |
|----------------|---------------------|----------|-----------|---------|---------------------|----------|-----------|---------|
|                | Males.              | Females. | Children. | Totals. | Males.              | Females. | Children. | Totals. |
| April.....     | 30,103              | 7,155    | 6,793     | 44,051  | 19,311              | 5,342    | 5,100     | 29,753  |
| May.....       | 28,493              | 8,675    | 8,509     | 45,677  | 13,168              | 5,418    | 4,998     | 23,584  |
| June.....      | 20,913              | 8,450    | 8,280     | 37,643  | 7,800               | 4,439    | 3,397     | 15,636  |
| July.....      | 14,601              | 6,150    | 5,590     | 26,341  | 5,611               | 3,191    | 2,528     | 11,330  |
| August.....    | 10,744              | 5,508    | 4,760     | 21,012  | 5,062               | 2,765    | 2,255     | 10,082  |
| September..... | 10,039              | 5,074    | 3,944     | 19,057  | 5,367               | 2,829    | 1,896     | 10,092  |
| October.....   | 9,374               | 4,779    | 4,090     | 18,243  | 4,248               | 2,640    | 2,201     | 9,089   |
| November.....  | 7,516               | 3,583    | 3,166     | 14,265  | 3,359               | 1,924    | 1,747     | 7,030   |
| December.....  | 5,513               | 1,899    | 1,624     | 9,036   | 2,670               | 1,215    | 1,075     | 4,960   |
| January.....   | 3,174               | 1,274    | 1,119     | 5,567   | 2,247               | 976      | 874       | 4,097   |
| February.....  | 3,609               | 1,434    | 1,121     | 6,164   | 2,963               | 1,033    | 795       | 4,791   |
| March.....     | 9,749               | 2,931    | 2,733     | 15,413  | 10,359              | 3,011    | 3,094     | 16,464  |
| Totals.....    | 153,828             | 56,912   | 51,729    | 262,469 | 82,165              | 34,783   | 29,960    | 146,908 |

9-10 EDWARD VII., A. 1910

## COMPARATIVE STATEMENT.

TOTAL Immigrants arriving for Canada, by ports, for the fiscal year ending March 31, 1909, and for the fiscal year ending March 31, 1908.

|  | FISCAL YEAR 1907-8. |          |           |         | FISCAL YEAR 1908-9. |          |           |         |
|--|---------------------|----------|-----------|---------|---------------------|----------|-----------|---------|
|  | Males.              | Females. | Children. | Totals. | Males.              | Females. | Children. | Totals. |
| North Sydney.  | 2,726               | 618      | 378       | 3,722   | 1,822               | 409      | 159       | 2,390   |
| Halifax.   | 17,857              | 5,514    | 4,948     | 28,319  | 7,839               | 2,916    | 2,624     | 13,379  |
| St. John.  | 11,913              | 3,454    | 2,527     | 17,894  | 8,855               | 2,743    | 2,003     | 13,601  |
| Quebec.  | 57,218              | 28,708   | 26,398    | 112,324 | 18,452              | 14,446   | 11,172    | 44,070  |
| Vancouver.   | 6,218               | 208      | 140       | 6,566   | 1,293               | 103      | 121       | 1,517   |
| Victoria.  | 5,401               | 487      | 135       | 6,024   | 1,003               | 181      | 118       | 1,302   |
| Via United States ports, (New York, Portland, Boston, Baltimore and Philadelphia). | 20,960              | 4,552    | 3,796     | 29,308  | 7,073               | 2,100    | 1,644     | 10,817  |
| From the United States.  | 31,535              | 13,371   | 13,406    | 58,312  | 35,828              | 11,885   | 12,119    | 59,832  |
| Totals.  | 153,828             | 56,912   | 51,729    | 262,469 | 82,165              | 34,783   | 29,960    | 146,908 |

## COMPARATIVE STATEMENT.

TOTAL Immigrants arriving from the United States, direct, by months, for the fiscal year ending March 31, 1909, and for the fiscal year ending March 31, 1908.

|            | FISCAL YEAR 1907-8. |          |           |         | FISCAL YEAR 1908-9. |          |           |         |
|------------|---------------------|----------|-----------|---------|---------------------|----------|-----------|---------|
|            | Males.              | Females. | Children. | Totals. | Males.              | Females. | Children. | Totals. |
| April.     | 5,131               | 2,103    | 2,379     | 9,613   | 5,676               | 1,531    | 1,877     | 9,084   |
| May.       | 3,749               | 1,522    | 1,651     | 6,922   | 3,923               | 1,209    | 1,307     | 6,439   |
| June.      | 2,806               | 1,279    | 1,239     | 5,324   | 2,876               | 1,047    | 961       | 4,884   |
| July.      | 2,760               | 1,455    | 1,180     | 5,395   | 2,684               | 1,003    | 792       | 4,479   |
| August.    | 2,160               | 1,077    | 839       | 4,076   | 3,027               | 907      | 759       | 4,684   |
| September. | 1,954               | 1,019    | 880       | 3,853   | 2,965               | 971      | 753       | 4,689   |
| October.   | 2,435               | 1,139    | 1,072     | 4,646   | 2,582               | 1,030    | 973       | 4,585   |
| November.  | 2,140               | 951      | 1,065     | 4,156   | 2,145               | 889      | 994       | 4,028   |
| December.  | 1,627               | 615      | 695       | 2,937   | 1,655               | 597      | 610       | 2,862   |
| January.   | 1,542               | 606      | 614       | 2,762   | 1,317               | 480      | 499       | 2,296   |
| February.  | 1,446               | 525      | 495       | 2,466   | 1,566               | 542      | 512       | 2,620   |
| March.     | 3,785               | 1,080    | 1,297     | 6,162   | 5,412               | 1,679    | 2,091     | 9,182   |
| Totals.    | 31,535              | 13,371   | 13,406    | 58,312  | 35,828              | 11,885   | 12,119    | 59,832  |



9-10 EDWARD VII.; A. 1910

## COMPARATIVE STATEMENT.

IMMIGRANTS arriving for Canada, by nationalities, for the fiscal year 1908-9, and for the fiscal year 1907-8, showing increase or decrease of each nationality.

|  | Fiscal Year,<br>1907-8. | Fiscal Year,<br>1908-9. | Increase. | Decrease. |
|--|-------------------------|-------------------------|-----------|-----------|
| English.....                               | 90,380                  | 37,019                  |           | 53,361    |
| Welsh.....                                 | 1,032                   | 463                     |           | 569       |
| Scotch.....                                | 22,223                  | 11,810                  |           | 10,413    |
| Irish.....                                 | 6,547                   | 3,609                   |           | 2,938     |
| Total British.....                         | 120,182                 | 52,901                  |           | 67,281    |
| African, South.....                        | 76                      | 53                      |           | 23        |
| Australian.....                            | 180                     | 171                     |           | 9         |
| Austrian, N.E.S.....                       | 1,899                   | 1,830                   |           | 69        |
| Bohemian.....                              | 102                     | 28                      |           | 74        |
| Bukowinian.....                            | 2,145                   | 1,546                   |           | 599       |
| Croatian.....                              | 224                     | 1                       |           | 223       |
| Dalmatian.....                             | 10                      | 1                       |           | 9         |
| Galician.....                              | 14,268                  | 6,644                   |           | 7,624     |
| Hungarian, N.E.S.....                      | 1,307                   | 595                     |           | 712       |
| Magyar.....                                | 321                     | 4                       |           | 317       |
| Ruthenian.....                             | 912                     | 149                     |           | 763       |
| Slovak.....                                | 188                     |                         |           | 188       |
| Belgian.....                               | 1,214                   | 828                     |           | 386       |
| Bulgarian.....                             | 2,529                   | 56                      |           | 2,473     |
| Brazilian.....                             | 1                       | 4                       | 3         |           |
| Chinese.....                               | 1,884                   | 1,887                   | 3         |           |
| Dutch.....                                 | 1,212                   | 495                     |           | 717       |
| French.....                                | 2,671                   | 1,830                   |           | 841       |
| German, N.E.S.....                         | 2,363                   | 1,257                   |           | 1,106     |
| Alsatian.....                              | 2                       | 1                       |           | 1         |
| Bavarian.....                              | 7                       | 7                       |           | 7         |
| Prussian.....                              | 5                       | 74                      | 69        |           |
| Saxon.....                                 |                         | 8                       | 8         |           |
| West Indian.....                           | 134                     | 113                     |           | 21        |
| Bermudian.....                             | 43                      | 14                      |           | 29        |
| Jamaican.....                              | 101                     | 32                      |           | 69        |
| Greek.....                                 | 1,053                   | 192                     |           | 861       |
| Hebrew, N.E.S.....                         | 1,679                   | 151                     |           | 1,528     |
| " Russian.....                             | 5,738                   | 1,444                   |           | 4,294     |
| " Polish.....                              | 46                      | 2                       |           | 44        |
| " Austrian.....                            | 195                     | 24                      |           | 171       |
| " German.....                              | 54                      | 15                      |           | 39        |
| Italian.....                               | 11,212                  | 4,228                   |           | 6,984     |
| Japanese.....                              | 7,601                   | 495                     |           | 7,106     |
| Newfoundland.....                          | 3,374                   | 2,108                   |           | 1,266     |
| New Zealand.....                           | 70                      | 65                      |           | 5         |
| Portuguese.....                            | 2                       | 2                       |           |           |
| Polish, N.E.S.....                         | 255                     | 76                      |           | 179       |
| " Austrian.....                            | 586                     | 42                      |           | 544       |
| " German.....                              | 16                      | 3                       |           | 13        |
| " Russian.....                             | 736                     | 255                     |           | 481       |
| Persian.....                               | 7                       | 1                       |           | 6         |
| Romanian.....                              | 949                     | 278                     |           | 671       |
| Russian, N.E.S.....                        | 6,281                   | 3,547                   |           | 2,734     |
| Finnish.....                               | 1,212                   | 669                     |           | 543       |
| Spanish.....                               | 61                      | 32                      |           | 29        |
| Swiss.....                                 | 195                     | 129                     |           | 66        |
| Servian.....                               | 48                      | 31                      |           | 17        |
| Danish.....                                | 290                     | 160                     |           | 130       |
| Icelandic.....                             | 97                      | 35                      |           | 62        |
| Swedish.....                               | 2,132                   | 1,135                   |           | 997       |
| Norwegian.....                             | 1,554                   | 752                     |           | 802       |
| Turkish.....                               | 489                     | 236                     |           | 253       |
| Armenian.....                              | 563                     | 79                      |           | 484       |
| Egyptian.....                              | 8                       | 2                       |           | 6         |
| Syrian.....                                | 732                     | 189                     |           | 543       |
| Arabian.....                               | 50                      | 4                       |           | 46        |
| U.S.A. Citizens (through ocean ports)..... | 133                     | 94                      |           | 39        |
| Negro.....                                 | 136                     | 73                      |           | 63        |
| Hindoo.....                                | 2,623                   | 6                       |           | 2,617     |
| Total Continental, &c.....                 | 83,975                  | 34,175                  |           | 49,800    |
| United States (direct).....                | 58,312                  | 59,832                  | 1,520     |           |
| Total Immigration.....                     | 262,469                 | 146,908                 |           | 115,561   |

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## ARRIVALS AT OCEAN PORTS.

For the fiscal year 1908-9, there arrived, via Canadian and United States ocean ports 145,431 passengers, of whom 14,588 travelled saloon and 130,843 steerage. Of the saloon passengers, 11,916 were destined to Canada and 2,672 to the United States. Of the steerage passengers, 113,452 were for Canada and 17,391 for the United States. Included in the steerage passengers for Canada were 21,501 returned Canadians and 4,875 tourists, leaving the immigration proper via ocean ports at 87,076 souls, which together with the 59,832 settlers direct from the United States, brings the total immigration to 146,908, a decrease as compared with the preceding fiscal year of 115,561 persons.

The following further statistical information will be of interest :—Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

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TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at Ocean Ports, for the Fiscal Year ending March 31, 1909.

|                     | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|---------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                     | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South..... | 1       | 1        | 1         | 3       | 2              |          |           | 2       | 3                         | 1        | 1         | 5       |
| Australian.....     | 79      | 92       | 22        | 193     | 25             | 17       | 5         | 47      | 104                       | 109      | 27        | 240     |
| Austrian.....       | 13      |          |           | 13      | 1              | 1        |           | 2       | 14                        | 1        |           | 15      |
| Belgian.....        | 7       | 4        |           | 11      | 2              |          |           | 2       | 9                         | 4        |           | 13      |
| Chinese.....        | 12      | 1        | 5         | 18      | 6              | 3        |           | 9       | 18                        | 4        | 5         | 27      |
| Dutch.....          | 13      | 4        |           | 17      | 1              |          |           | 1       | 14                        | 4        |           | 18      |
| French.....         | 132     | 93       | 20        | 245     | 17             | 12       | 5         | 34      | 149                       | 105      | 25        | 279     |
| German.....         | 38      | 13       |           | 51      | 17             | 9        |           | 26      | 55                        | 22       |           | 77      |
| English.....        | 2,246   | 1,229    | 188       | 3,663   | 135            | 56       | 10        | 201     | 2,381                     | 1,285    | 198       | 3,864   |
| Welsh.....          | 38      | 15       |           | 53      | 4              | 1        |           | 5       | 42                        | 16       |           | 58      |
| Scotch.....         | 529     | 302      | 42        | 873     | 58             | 34       |           | 92      | 587                       | 336      | 42        | 965     |
| Irish.....          | 117     | 71       | 8         | 196     | 9              | 10       |           | 19      | 126                       | 81       | 8         | 215     |
| West Indian.....    | 48      | 55       | 25        | 128     | 9              | 5        | 1         | 15      | 57                        | 60       | 26        | 143     |
| Bermudian.....      | 2       | 5        | 1         | 8       |                |          |           |         | 2                         | 5        | 1         | 8       |
| Jamaican.....       | 5       |          |           | 5       | 1              |          |           | 1       | 6                         |          |           | 6       |
| Greek.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Italian.....        | 17      | 1        |           | 18      | 1              | 2        |           | 3       | 18                        | 3        |           | 21      |
| Japanese.....       | 23      | 6        | 3         | 32      | 5              | 5        | 2         | 12      | 28                        | 11       | 5         | 44      |
| Newfoundland.....   | 312     | 207      | 21        | 540     | 115            | 116      | 3         | 234     | 427                       | 323      | 24        | 774     |
| New Zealand.....    | 41      | 37       | 4         | 82      | 9              | 4        |           | 13      | 50                        | 41       | 4         | 95      |
| Portuguese.....     | 3       | 1        |           | 4       |                |          |           |         | 3                         | 1        |           | 4       |
| Russian.....        | 7       | 2        |           | 9       | 2              | 2        |           | 4       | 9                         | 4        |           | 13      |
| Finnish.....        |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Spanish.....        | 7       | 1        |           | 8       | 2              |          |           | 2       | 9                         | 1        |           | 10      |
| Swiss.....          | 6       | 1        | 1         | 8       | 1              |          |           | 1       | 7                         | 1        | 1         | 9       |
| Danish.....         | 2       | 1        | 3         | 6       |                |          |           |         | 4                         | 1        | 3         | 8       |
| Swedish.....        | 10      | 4        |           | 14      | 5              |          |           | 5       | 15                        | 4        |           | 19      |
| Norwegian.....      | 1       | 4        |           | 5       | 1              | 1        |           | 2       | 2                         | 5        |           | 7       |
| Armenian.....       |         |          |           |         | 1              | 1        |           | 2       | 1                         | 1        |           | 2       |
| Egyptian.....       | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Syrian.....         | 3       |          |           | 3       | 2              |          |           | 2       | 5                         |          |           | 5       |
| U. S. A. citizens.. | 139     | 72       | 16        | 227     | 937            | 837      | 105       | 1,879   | 1,076                     | 909      | 121       | 2,106   |
| Negro.....          | 2       | 1        |           | 3       |                |          |           |         | 2                         | 1        |           | 3       |
| Hindoo.....         | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Canadian.....       | 2,279   | 1,642    | 317       | 4,238   | 17             | 3        | 3         | 23      | 2,296                     | 1,645    | 320       | 4,261   |
| Tourist.....        | 687     | 466      | 84        | 1,237   | 16             | 12       | 3         | 31      | 703                       | 478      | 87        | 1,268   |
| Totals.....         | 6,824   | 4,331    | 761       | 11,916  | 1,404          | 1,131    | 137       | 2,672   | 8,228                     | 5,462    | 898       | 14,588  |



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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at Ocean Ports, for the Fiscal Year ending March 31, 1909.

|                   | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|-------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                   | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South... | 21      | 18       | 14        | 53      | 4              | 2        | 13        | 19      | 25                        | 20       | 27        | 72      |
| Australian...     | 86      | 48       | 37        | 171     | 81             | 73       | 37        | 191     | 167                       | 121      | 74        | 362     |
| Austrian, N.E.S.  | 1,225   | 316      | 289       | 1,830   | 185            | 83       | 33        | 301     | 1,410                     | 399      | 322       | 2,131   |
| Bohemian          | 7       | 14       | 7         | 28      | 7              | 2        | ...       | 9       | 14                        | 16       | 7         | 37      |
| Bukovinian        | 1,353   | 101      | 92        | 1,546   | 3              | 1        | ...       | 4       | 1,356                     | 102      | 92        | 1,550   |
| Croatian          | 1       | ...      | ...       | 1       | 5              | ...      | ...       | 5       | 6                         | ...      | ...       | 6       |
| Dalmatian         | ...     | 1        | ...       | 1       | ...            | ...      | ...       | ...     | 1                         | ...      | ...       | 1       |
| Galician          | 4,657   | 992      | 995       | 6,644   | 21             | 28       | 17        | 66      | 4,678                     | 1,020    | 1,012     | 6,710   |
| Hungarian, N.E.S. | 393     | 107      | 95        | 595     | 42             | 44       | 34        | 120     | 435                       | 151      | 129       | 715     |
| Magyar            | ...     | 1        | 3         | 4       | ...            | ...      | ...       | ...     | 1                         | ...      | 3         | 4       |
| Ruthenian         | 127     | 9        | 13        | 149     | ...            | ...      | ...       | ...     | 127                       | 9        | 13        | 149     |
| Belgian           | 401     | 210      | 217       | 828     | 40             | 19       | 26        | 85      | 441                       | 229      | 243       | 913     |
| Bulgarian         | 52      | 4        | ...       | 56      | 12             | 5        | 3         | 20      | 64                        | 9        | 3         | 76      |
| Brazilian         | ...     | ...      | 4         | 4       | ...            | ...      | ...       | ...     | ...                       | ...      | 4         | 4       |
| Chinese           | 1,695   | 36       | 156       | 1,887   | 130            | 4        | 2         | 136     | 1,825                     | 40       | 158       | 2,023   |
| Dutch             | 227     | 135      | 133       | 495     | 35             | 19       | 19        | 73      | 262                       | 154      | 152       | 568     |
| French            | 1,143   | 460      | 227       | 1,830   | 47             | 34       | 18        | 99      | 1,190                     | 494      | 245       | 1,929   |
| German, N.E.S.    | 588     | 326      | 343       | 1,257   | 186            | 133      | 106       | 425     | 774                       | 459      | 449       | 1,682   |
| Alsatian          | 1       | ...      | ...       | 1       | ...            | ...      | ...       | ...     | 23                        | ...      | ...       | 23      |
| Prussian          | 22      | 15       | 37        | 74      | 1              | 1        | 3         | 5       | 2                         | 16       | 40        | 79      |
| Saxon             | ...     | 1        | 7         | 8       | 1              | ...      | ...       | 1       | 1                         | 1        | 7         | 9       |
| English           | 16,512  | 11,336   | 9,171     | 37,019  | 938            | 670      | 381       | 1,989   | 17,450                    | 12,006   | 9,552     | 39,008  |
| Welsh             | 231     | 132      | 100       | 463     | 39             | 22       | 12        | 73      | 270                       | 154      | 112       | 536     |
| Scotch            | 5,342   | 3,959    | 2,509     | 11,810  | 312            | 206      | 112       | 630     | 5,654                     | 4,165    | 2,621     | 12,440  |
| Irish             | 1,733   | 1,278    | 598       | 3,609   | 103            | 98       | 30        | 291     | 1,896                     | 1,376    | 628       | 3,900   |
| West Indian       | 58      | 48       | 7         | 113     | 16             | 7        | 3         | 26      | 74                        | 55       | 10        | 139     |
| Bermudian         | 4       | 8        | 2         | 14      | ...            | ...      | ...       | ...     | 4                         | 8        | 2         | 14      |
| Jamaican          | 20      | 12       | ...       | 32      | ...            | ...      | ...       | ...     | 20                        | 12       | ...       | 32      |
| Greek             | 165     | 13       | 14        | 192     | 78             | ...      | 6         | 84      | 243                       | 13       | 20        | 276     |
| Hebrew, N.E.S.    | 55      | 46       | 50        | 151     | 24             | 13       | 23        | 60      | 79                        | 59       | 73        | 211     |
| " Russian         | 460     | 485      | 498       | 1,444   | 28             | 31       | 39        | 98      | 488                       | 517      | 537       | 1,542   |
| " Polish          | 2       | ...      | ...       | 2       | ...            | ...      | ...       | ...     | 2                         | ...      | ...       | 2       |
| " Austrian        | 9       | 6        | 9         | 24      | ...            | ...      | ...       | ...     | 9                         | 6        | 9         | 24      |
| " German          | 6       | 5        | 4         | 15      | ...            | ...      | ...       | ...     | 6                         | 5        | 4         | 15      |
| Italian           | 3,567   | 394      | 267       | 4,228   | 31             | 7        | 6         | 44      | 3,598                     | 401      | 273       | 4,272   |
| Japanese          | 312     | 153      | 30        | 495     | 31             | 20       | ...       | 51      | 343                       | 173      | 30        | 546     |
| Newfoundland      | 1,605   | 374      | 129       | 2,108   | 537            | 372      | 33        | 942     | 2,142                     | 746      | 162       | 3,050   |
| New Zealand       | 36      | 17       | 12        | 65      | 32             | 12       | 4         | 48      | 68                        | 29       | 16        | 113     |
| Portuguese        | 1       | 1        | ...       | 2       | 7              | ...      | ...       | 7       | 8                         | 1        | ...       | 9       |
| Polish, N.E.S.    | 50      | 15       | 11        | 76      | 23             | 14       | 7         | 44      | 73                        | 29       | 18        | 120     |
| " Austrian        | 40      | 1        | 1         | 42      | 2              | ...      | ...       | 2       | 42                        | 1        | 1         | 44      |
| " German          | 3       | ...      | ...       | 3       | ...            | ...      | ...       | ...     | 3                         | ...      | ...       | 3       |
| " Russian         | 127     | 62       | 66        | 255     | 4              | 10       | 9         | 23      | 131                       | 72       | 75        | 278     |
| Persian           | 1       | ...      | ...       | 1       | ...            | ...      | ...       | ...     | 1                         | ...      | ...       | 1       |
| Roumanian         | 114     | 82       | 82        | 278     | 14             | 12       | 9         | 35      | 128                       | 94       | 91        | 313     |
| Russian, N.E.S.   | 1,672   | 815      | 1,060     | 3,547   | 577            | 460      | 597       | 1,544   | 2,249                     | 1,275    | 1,567     | 5,091   |
| Finnish           | 428     | 158      | 83        | 669     | 1,579          | 402      | 242       | 2,223   | 2,067                     | 560      | 325       | 2,892   |
| Spanish           | 24      | 3        | 5         | 32      | 4              | 1        | ...       | 5       | 28                        | 4        | 5         | 37      |
| Swiss             | 87      | 27       | 15        | 129     | 16             | 18       | 10        | 44      | 103                       | 45       | 25        | 173     |
| Servian           | 6       | 5        | 20        | 31      | 9              | 5        | 5         | 19      | 15                        | 10       | 25        | 50      |
| Danish            | 106     | 44       | 10        | 160     | 161            | 69       | 54        | 284     | 267                       | 113      | 64        | 444     |
| Icelandic         | 17      | 13       | 5         | 35      | ...            | 1        | ...       | 1       | 17                        | 14       | 5         | 36      |
| Swedish           | 633     | 291      | 211       | 1,135   | 558            | 287      | 147       | 992     | 1,191                     | 578      | 358       | 2,127   |
| Norwegian         | 432     | 181      | 139       | 752     | 977            | 549      | 264       | 1,790   | 1,409                     | 730      | 403       | 2,542   |
| Turkish           | 202     | 21       | 13        | 236     | 33             | 5        | 5         | 43      | 235                       | 26       | 18        | 279     |
| Armenian          | 44      | 23       | 12        | 79      | 78             | 31       | 23        | 132     | 122                       | 51       | 35        | 211     |
| Egyptian          | 2       | ...      | ...       | 2       | 2              | ...      | ...       | 2       | 4                         | ...      | ...       | 4       |
| Syrian            | 120     | 41       | 28        | 189     | 22             | 10       | 6         | 38      | 142                       | 51       | 34        | 227     |
| Arabian           | 2       | 2        | ...       | 4       | ...            | ...      | ...       | ...     | 2                         | 2        | ...       | 4       |
| U.S.A. citizens   | 56      | 29       | 9         | 94      | 1,263          | 1,079    | 292       | 2,634   | 1,319                     | 1,108    | 301       | 2,728   |
| Negro             | 49      | 22       | 2         | 73      | ...            | ...      | ...       | ...     | 49                        | 22       | 2         | 73      |
| Hindoo            | 5       | 1        | ...       | 6       | 2              | ...      | ...       | 2       | 7                         | 1        | ...       | 8       |
| Total immigration | 46,337  | 22,898   | 17,841    | 87,076  | 8,360          | 4,859    | 2,540     | 15,759  | 54,697                    | 27,757   | 20,381    | 102,835 |
| Returned Canadian | 15,320  | 4,438    | 1,743     | 21,501  | ...            | ...      | ...       | ...     | 15,320                    | 4,438    | 1,743     | 21,501  |
| Tourist           | 3,412   | 1,279    | 184       | 4,875   | 1,283          | 258      | 91        | 1,632   | 4,695                     | 1,537    | 275       | 6,507   |
| Totals            | 65,069  | 28,615   | 19,768    | 113,452 | 9,643          | 5,117    | 2,631     | 17,391  | 74,712                    | 33,732   | 22,399    | 130,843 |

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TABLE III.

MONTHLY arrivals of Immigrants, for Canada, at Ocean Ports, for the Fiscal Year ending March 31, 1909.

|                   | Apr.   | May.   | June.  | July. | Aug.  | Sept. | Oct.  | Nov.  | Dec.  | Jan.  | Feb.  | Mar.  | Totals |
|-------------------|--------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| African, South    | 3      | 4      | 2      | 5     | 2     | 13    | 8     | 2     | 4     | 7     | 3     |       | 53     |
| Australian        | 9      | 18     | 48     | 16    | 10    | 13    | 8     | 11    | 7     | 9     | 5     | 17    | 171    |
| Austrian, N.E.S.  | 591    | 224    | 223    | 77    | 60    | 96    | 109   | 118   | 54    | 55    | 77    | 146   | 1,830  |
| Bohemian          | 7      | 2      | 5      | 2     | 7     |       | 1     | 1     |       | 1     |       | 2     | 28     |
| Bukowinian        | 969    | 415    | 103    | 11    | 3     | 13    |       | 6     |       | 1     | 1     | 21    | 1,546  |
| Croatian          |        | 1      |        |       |       |       |       |       |       |       |       |       | 1      |
| Dalmatian         |        | 1      |        |       |       |       |       |       |       |       |       |       | 1      |
| Galician          | 3,277  | 2,080  | 774    | 58    | 106   | 51    | 31    | 55    | 15    | 61    | 20    | 116   | 6,644  |
| Hungarian, N.E.S. | 105    | 44     | 48     | 37    | 19    | 23    | 35    | 29    | 45    | 55    | 52    | 103   | 595    |
| Magyar            | 4      |        |        |       |       |       |       |       |       |       |       |       | 4      |
| Ruthenian         | 122    | 27     |        |       |       |       |       |       |       |       |       |       | 149    |
| Belgian           | 184    | 179    | 65     | 42    | 38    | 50    | 46    | 17    | 23    | 50    | 31    | 112   | 828    |
| Bulgarian         | 2      | 30     | 5      |       | 11    | 2     |       | 2     | 1     |       |       | 3     | 56     |
| Brazilian         |        |        |        |       |       |       |       |       |       |       |       |       | 4      |
| Chinese           | 199    | 445    | 154    | 478   | 197   | 133   | 86    | 80    | 58    | 44    | 22    | 51    | 1,887  |
| Dutch             | 102    | 76     | 41     | 36    | 22    | 44    | 21    | 11    | 19    | 4     | 7     | 112   | 495    |
| French            | 279    | 406    | 196    | 169   | 141   | 163   | 144   | 71    | 50    | 34    | 42    | 144   | 1,830  |
| German, N.E.S.    | 282    | 162    | 141    | 97    | 87    | 83    | 100   | 67    | 32    | 53    | 45    | 108   | 1,257  |
| Alsatian          | 1      |        |        |       |       |       |       |       |       |       |       |       | 1      |
| Prussian          | 22     | 1      |        |       | 3     | 1     |       |       | 47    |       |       |       | 74     |
| Saxon             |        |        |        |       |       | 8     |       |       |       |       |       |       | 8      |
| English           | 8,360  | 7,616  | 4,515  | 3,373 | 2,606 | 2,221 | 2,149 | 1,125 | 664   | 538   | 747   | 3,105 | 37,019 |
| Welsh             | 98     | 67     | 49     | 38    | 38    | 48    | 33    | 31    | 11    | 5     | 5     | 40    | 493    |
| Scotch            | 2,257  | 2,044  | 2,338  | 995   | 742   | 1,059 | 698   | 297   | 250   | 186   | 216   | 908   | 11,810 |
| Irish             | 669    | 634    | 510    | 353   | 322   | 327   | 204   | 131   | 86    | 41    | 53    | 274   | 3,609  |
| West Indian       | 6      | 24     | 16     | 13    | 13    | 23    | 3     | 2     | 3     | 2     | 2     | 6     | 113    |
| Bermudian         | 3      |        |        | 2     | 2     |       | 3     | 1     |       |       | 1     |       | 14     |
| Jamaican          | 3      | 1      | 8      | 4     |       | 3     | 9     | 2     |       |       |       |       | 32     |
| Greek             | 44     | 12     | 11     | 16    | 27    | 6     | 1     | 3     | 16    | 3     | 7     | 46    | 192    |
| Hebrew, N.E.S.    | 22     | 23     | 25     | 11    | 19    |       | 2     | 12    | 8     | 23    | 6     |       | 151    |
| Russian           | 187    | 151    | 169    | 193   | 131   | 156   | 69    | 89    | 89    | 67    | 75    | 77    | 1,444  |
| Polish            | 1      |        |        | 1     |       |       |       |       |       |       |       |       | 2      |
| Austrian          | 11     | 6      | 2      |       |       | 4     |       | 1     |       |       |       |       | 24     |
| German            | 2      | 4      |        |       |       |       |       | 7     |       | 2     |       |       | 15     |
| Italian           | 1,237  | 1,005  | 199    | 84    | 111   | 115   | 126   | 112   | 118   | 83    | 275   | 763   | 4,228  |
| Japanese          | 152    | 113    | 51     | 39    | 27    | 21    | 31    | 12    | 16    | 11    | 13    | 9     | 495    |
| Newfoundland      | 303    | 307    | 183    | 113   | 193   | 222   | 177   | 218   | 83    | 63    | 37    | 209   | 2,108  |
| New Zealand       | 11     | 6      | 23     | 4     | 4     | 2     | 1     | 6     |       | 1     | 3     | 4     | 65     |
| Portuguese        | 2      |        |        |       |       |       |       |       |       |       |       |       | 2      |
| Polish, N.E.S.    | 2      | 6      | 23     | 2     | 2     | 14    | 5     | 1     | 1     |       | 11    | 9     | 76     |
| Austrian          | 35     | 3      |        |       | 4     |       |       |       |       |       |       |       | 42     |
| German            |        | 1      |        | 2     |       |       |       |       |       |       |       |       | 3      |
| Russian           | 33     | 44     | 69     | 25    | 21    | 4     | 7     | 10    |       | 23    |       | 19    | 255    |
| Persian           |        |        |        |       | 1     |       |       |       |       |       |       |       | 1      |
| Roumanian         | 50     | 43     | 31     | 34    | 4     | 12    | 20    | 15    | 26    | 3     | 10    | 30    | 278    |
| Russian, N.E.S.   | 654    | 510    | 381    | 333   | 157   | 192   | 172   | 312   | 161   | 198   | 162   | 315   | 3,547  |
| Finnish           | 29     | 29     | 28     | 44    | 39    | 41    | 53    | 50    | 89    | 86    | 86    | 95    | 669    |
| Spanish           | 5      |        | 2      | 7     | 2     | 4     | 9     | 1     | 2     |       |       |       | 32     |
| Swiss             | 8      | 28     | 12     | 11    | 6     | 16    | 12    | 4     | 3     | 4     |       | 25    | 129    |
| Servian           |        | 1      |        |       |       |       |       |       | 1     |       |       |       | 29     |
| Danish            | 35     | 25     | 13     | 14    | 8     | 7     | 8     | 6     | 5     | 4     | 11    | 24    | 160    |
| Icelandic         | 5      | 2      | 10     | 3     | 2     |       | 8     |       | 3     |       |       | 1     | 35     |
| Swedish           | 116    | 192    | 120    | 123   | 84    | 106   | 83    | 41    | 50    | 25    | 67    | 128   | 1,135  |
| Norwegian         | 93     | 77     | 86     | 64    | 64    | 82    | 58    | 21    | 23    | 21    | 34    | 129   | 752    |
| Turkish           | 5      | 38     | 6      | 6     | 1     | 9     | 31    | 17    | 11    | 13    | 27    | 72    | 236    |
| Armenian          | 25     | 2      | 5      | 16    |       | 1     | 5     | 2     | 13    | 1     | 1     | 8     | 79     |
| Egyptian          |        |        |        |       | 1     |       |       |       | 1     |       |       |       | 2      |
| Syrian            | 11     | 6      | 30     | 33    | 37    | 10    | 15    | 1     | 14    | 18    | 10    | 4     | 189    |
| Arabian           |        |        |        |       | 1     |       | 1     | 1     | 1     |       |       |       | 4      |
| U.S.A. citizens   | 12     | 15     | 10     | 11    | 18    | 4     | 1     | 1     | 5     | 4     | 6     | 7     | 94     |
| Negro             | 34     | 2      | 20     |       | 5     | 1     | 10    |       | 1     |       |       |       | 73     |
| Hindoo            |        | 2      | 2      | 1     |       |       | 1     |       |       |       |       |       | 6      |
| Totals            | 20,669 | 17,145 | 10,752 | 6,851 | 5,398 | 5,403 | 4,504 | 3,002 | 2,098 | 1,801 | 2,171 | 7,282 | 87,076 |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Destination at Ocean Ports, for the Fiscal Year ending March 31, 1909.

|                    | April.        | May.          | June.         | July.        | August.      | September.   | October.     | November.    | December.    | January.     | February.    | March.       | Totals.       |
|--------------------|---------------|---------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| Agriculturists..   | 6,613         | 5,839         | 3,533         | 1,792        | 1,296        | 953          | 913          | 587          | 478          | 306          | 550          | 2,793        | 25,614        |
| General            |               |               |               |              |              |              |              |              |              |              |              |              |               |
| labourers.....     | 6,528         | 3,040         | 1,458         | 949          | 696          | 693          | 595          | 663          | 446          | 479          | 605          | 2,227        | 18,379        |
| Mechanics.....     | 3,888         | 3,791         | 2,625         | 1,711        | 1,357        | 1,834        | 1,172        | 623          | 325          | 334          | 352          | 926          | 18,938        |
| Clerks.....        | 1,139         | 1,576         | 1,136         | 842          | 669          | 507          | 469          | 296          | 241          | 167          | 182          | 440          | 7,664         |
| Miners.....        | 355           | 327           | 259           | 236          | 196          | 259          | 183          | 116          | 96           | 99           | 103          | 124          | 2,353         |
| Female servants    | 1,067         | 1,055         | 1,000         | 564          | 536          | 575          | 562          | 361          | 190          | 150          | 147          | 408          | 6,615         |
| Not classed.....   | 1,079         | 1,526         | 741           | 757          | 648          | 582          | 610          | 356          | 322          | 266          | 232          | 364          | 7,483         |
| <b>Totals.....</b> | <b>20,669</b> | <b>17,145</b> | <b>10,752</b> | <b>6,851</b> | <b>5,398</b> | <b>5,403</b> | <b>4,504</b> | <b>3,002</b> | <b>2,098</b> | <b>1,801</b> | <b>2,171</b> | <b>7,282</b> | <b>87,076</b> |
| <b>Maritime</b>    |               |               |               |              |              |              |              |              |              |              |              |              |               |
| Provinces.....     | 1,419         | 836           | 462           | 384          | 438          | 413          | 412          | 395          | 298          | 252          | 170          | 665          | 6,144         |
| Quebec.....        | 3,566         | 3,743         | 1,901         | 1,268        | 1,110        | 1,600        | 968          | 672          | 347          | 308          | 500          | 899          | 16,882        |
| Ontario.....       | 6,452         | 5,495         | 3,239         | 2,244        | 1,739        | 1,469        | 1,449        | 811          | 622          | 489          | 676          | 2,335        | 27,020        |
| Manitoba.....      | 4,723         | 3,011         | 1,969         | 997          | 714          | 636          | 475          | 357          | 245          | 238          | 233          | 1,332        | 14,930        |
| Saskatchewan..     | 1,545         | 1,241         | 1,079         | 536          | 387          | 345          | 314          | 180          | 162          | 123          | 197          | 636          | 6,655         |
| Alberta.....       | 1,311         | 1,159         | 831           | 507          | 403          | 304          | 324          | 182          | 116          | 124          | 169          | 679          | 6,100         |
| British            |               |               |               |              |              |              |              |              |              |              |              |              |               |
| Columbia.....      | 1,653         | 1,669         | 1,271         | 915          | 607          | 634          | 562          | 405          | 308          | 267          | 315          | 735          | 9,341         |
| Yukon.....         |               |               |               |              |              | 2            |              |              |              |              | 1            | 1            | 4             |
| <b>Totals.....</b> | <b>20,669</b> | <b>17,145</b> | <b>10,752</b> | <b>6,851</b> | <b>5,398</b> | <b>5,403</b> | <b>4,504</b> | <b>3,002</b> | <b>2,098</b> | <b>1,801</b> | <b>2,171</b> | <b>7,282</b> | <b>87,076</b> |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals

|                   | SEX.   |          |           |          |        |          | TRADE OR                                 |        |          |                       |        |          |            |  |  |
|-------------------|--------|----------|-----------|----------|--------|----------|--|--------|----------|-----------------------|--------|----------|------------|--|--|
|                   | Males. |          |           | Females. |        |          | Farmers or<br>Farm Labour-<br>ers Class. |        |          | General<br>Labourers. |        |          | Mechanics. |  |  |
|                   | Males. | Females. | Children. | Totals.  | Males. | Females. | Children.                                | Males. | Females. | Children.             | Males. | Females. | Children.  |  |  |
| African, South    | 21     | 18       | 14        | 53       | 9      | 2        | 4  | 1      |          | 1                     | 5      | 6        | 4          |  |  |
| Australian        | 86     | 48       | 37        | 171      | 19     | 5        | 5  | 16     |          |                       | 22     | 8        | 7          |  |  |
| Austrian, N.E.S.  | 1,225  | 316      | 289       | 1,830    | 590    | 71       | 88                                       | 545    | 43       | 79                    | 66     | 30       | 23         |  |  |
| Bohemian          | 7      | 14       | 7         | 28       |        |          |  |        |          |                       | 2      | 1        | 1          |  |  |
| Bukowinian        | 1,353  | 101      | 92        | 1,546    | 325    | 28       | 53                                       | 985    | 20       | 24                    | 24     | 5        | 4          |  |  |
| Croatian          | 1      |          |           | 1        |        |          |  | 1      |          |                       |        |          |            |  |  |
| Dalmatian         |        | 1        |           | 1        |        | 1        |  |        |          |                       |        |          |            |  |  |
| Dutch             | 4,657  | 992      | 995       | 6,644    | 1,770  | 391      | 704                                      | 2,681  | 160      | 195                   | 144    | 32       | 27         |  |  |
| Hungarian, N.E.S. | 393    | 107      | 95        | 595      | 294    | 34       | 31                                       | 67     | 8        | 11                    | 20     | 8        | 9          |  |  |
| Magyar            |        | 1        | 3         | 4        |        |          |  |        |          |                       |        |          |            |  |  |
| Ruthenian         | 127    | 9        | 13        | 149      | 122    | 4        | 9  | 1      | 1        | 3                     | 4      |          |            |  |  |
| Belgian           | 401    | 210      | 217       | 828      | 149    | 58       | 86                                       | 58     | 15       | 10                    | 50     | 30       | 26         |  |  |
| Bulgarian         | 52     | 4        |           | 56       | 20     | 2        |  | 26     |          |                       | 4      |          |            |  |  |
| Brazilian         |        |          | 4         | 4        |        |          |  |        |          |                       |        |          |            |  |  |
| Chinese           | 1,695  | 36       | 156       | 1,887    | 24     |          | 1  | 559    |          | 8                     | 46     |          | 3          |  |  |
| Dutch             | 227    | 135      | 133       | 495      | 110    | 60       | 83                                       | 14     | 5        | 4                     | 41     | 21       | 20         |  |  |
| French            | 1,143  | 460      | 227       | 1,830    | 572    | 131      | 109                                      | 128    | 21       | 14                    | 196    | 79       | 46         |  |  |
| German, N.E.S.    | 588    | 326      | 343       | 1,257    | 214    | 91       | 149                                      | 123    | 40       | 57                    | 136    | 48       | 58         |  |  |
| Alsatian          | 1      |          |           | 1        | 1      |          |  |        |          |                       |        |          |            |  |  |
| Prussian          | 22     | 15       | 37        | 74       | 14     | 8        | 24                                       | 3      | 1        | 3                     | 2      |          |            |  |  |
| Saxon             |        | 1        |           | 1        |        | 1        |  |        |          |                       |        |          |            |  |  |
| English           | 16,512 | 11,336   | 9,171     | 37,019   | 6,604  | 2,120    | 1,952                                    | 2,190  | 983      | 1,304                 | 4,739  | 3,036    | 2,962      |  |  |
| Welsh             | 231    | 132      | 100       | 463      | 77     | 23       | 30                                       | 18     | 8        | 7                     | 75     | 35       | 42         |  |  |
| Scottish          | 5,342  | 3,959    | 2,509     | 11,810   | 1,901  | 510      | 562                                      | 549    | 224      | 262                   | 1,875  | 1,023    | 1,011      |  |  |
| Irish             | 1,733  | 1,278    | 598       | 3,609    | 745    | 145      | 115                                      | 243    | 65       | 95                    | 308    | 158      | 141        |  |  |
| West Indian       | 58     | 48       | 7         | 113      | 10     |          |  | 13     | 1        | 1                     | 10     | 3        |            |  |  |
| Bernaudian        | 4      | 8        | 2         | 14       |        |          |  | 1      |          |                       | 1      |          |            |  |  |
| Jamaican          | 20     | 12       |           | 32       |        |          |  |        |          |                       |        |          |            |  |  |
| Greek             | 165    | 13       | 14        | 192      | 20     |          |  | 122    | 5        | 7                     | 12     | 1        | 1          |  |  |
| Hebrew, N.E.S.    | 55     | 46       | 50        | 151      | 6      | 2        | 1  | 9      |          | 4                     | 29     | 28       | 35         |  |  |
| " Russian         | 460    | 486      | 498       | 1,444    | 49     | 29       | 30                                       | 105    | 33       | 31                    | 250    | 258      | 269        |  |  |
| " Polish          | 2      |          |           | 2        | 1      |          |  |        |          |                       | 1      |          |            |  |  |
| " Austrian        | 9      | 6        | 9         | 24       |        |          |  | 2      |          |                       | 4      | 3        | 3          |  |  |
| " German          | 6      | 5        | 4         | 15       | 1      | 1        | 2  |        |          |                       | 5      | 1        |            |  |  |
| Italian           | 3,567  | 391      | 297       | 4,228    | 1,183  | 45       | 38                                       | 2,069  | 62       | 48                    | 182    | 19       | 11         |  |  |
| Japanese          | 312    | 153      | 30        | 495      | 69     | 6        | 1  | 131    | 23       | 6                     | 17     | 3        | 1          |  |  |
| Newfoundland      | 1,605  | 374      | 129       | 2,108    | 32     | 1        | 4  | 1,289  | 33       | 24                    | 160    | 26       | 16         |  |  |
| New Zealand       | 36     | 17       | 12        | 65       | 9      | 1        | 2  | 5      |          |                       | 11     | 1        | 1          |  |  |
| Portuguese        | 1      | 1        |           | 2        |        | 1        |  |        |          |                       |        |          |            |  |  |
| Polish, N.E.S.    | 50     | 15       | 11        | 76       | 10     |          |  | 23     | 3        | 5                     | 4      | 5        | 3          |  |  |
| " Austrian        | 40     | 1        | 1         | 42       | 28     | 1        | 1  | 10     |          |                       | 2      |          |            |  |  |
| " German          | 3      |          |           | 3        | 1      |          |  |        |          |                       |        |          |            |  |  |
| " Russian         | 127    | 62       | 66        | 255      | 47     | 17       | 26                                       | 47     | 12       | 14                    | 12     | 10       | 16         |  |  |
| Persian           | 1      |          |           | 1        |        |          |  | 1      |          |                       |        |          |            |  |  |
| Roumanian         | 114    | 82       | 82        | 278      | 27     | 13       | 19                                       | 55     | 11       | 20                    | 24     | 20       | 18         |  |  |
| Russian, N.E.S.   | 1,672  | 815      | 1,060     | 3,547    | 664    | 279      | 493                                      | 745    | 108      | 204                   | 170    | 117      | 105        |  |  |
| Finnish           | 428    | 158      | 83        | 669      | 61     | 11       | 10                                       | 291    | 38       | 30                    | 34     | 10       | 15         |  |  |
| Spanish           | 24     | 3        | 5         | 32       |        |          |  | 4      |          |                       | 8      | 1        |            |  |  |
| Swiss             | 87     | 27       | 15        | 129      | 51     | 7        | 10                                       | 5      |          |                       | 16     | 3        |            |  |  |
| Servian           | 6      | 5        | 20        | 31       |        |          |  | 1      |          |                       |        |          |            |  |  |
| Danish            | 106    | 44       | 10        | 160      | 58     | 6        | 4  | 23     |          |                       | 18     | 5        | 2          |  |  |
| Icelandic         | 17     | 13       | 5         | 35       | 10     | 5        | 2  | 2      | 1        |                       | 3      | 2        | 1          |  |  |
| Swedish           | 633    | 291      | 211       | 1,135    | 268    | 87       | 116                                      | 257    | 32       | 30                    | 78     | 22       | 26         |  |  |
| Norwegian         | 432    | 181      | 139       | 752      | 176    | 45       | 69                                       | 203    | 24       | 37                    | 30     | 17       | 24         |  |  |
| Turkish           | 292    | 211      | 13        | 236      | 85     | 2        | 2  | 99     | 5        | 2                     | 10     |          | 1          |  |  |

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V.

for Canada at Ocean Ports, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.             |          |           |         |          |           |                     |                 |          |           | DESTINATION.           |         |          |           |               |          |                   |        |  |  |
|-------------------------|----------|-----------|---------|----------|-----------|---------------------|-----------------|----------|-----------|------------------------|---------|----------|-----------|---------------|----------|-------------------|--------|--|--|
| Clerks,<br>Traders, &c. |          |           | Miners. |          |           | Female<br>Servants. | Not Classified. |          |           | Maritime<br>Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. | Yukon. |  |  |
| Males.                  | Females. | Children. | Males.  | Females. | Children. |                     | Males.          | Females. | Children. |                        |         |          |           |               |          |                   |        |  |  |
| 3                       | 5        | 1         |         |          |           | 12                  | 3               | 3        | 4         | 5                      | 5       | 20       | 3         |               | 6        | 14                |        |  |  |
| 16                      | 6        | 1         | 6       | 1        |           | 11                  | 7               | 20       | 18        | 2                      | 19      | 22       | 6         | 4             | 13       | 104               |        |  |  |
| 24                      | 7        | 3         | 26      | 13       | 28        | 89                  | 4               | 63       | 68        | 94                     | 582     | 321      | 472       | 115           | 162      | 81                |        |  |  |
|                         |          |           | 5       | 3        | 5         | 10                  |                 | 1        | 1         | 1                      | 8       |          | 3         |               | 12       | 14                |        |  |  |
|                         |          |           | 19      | 2        | 3         | 41                  |                 | 5        | 8         | 140                    | 414     | 227      | 540       | 148           | 5        | 19                |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        |         | 1        |           |               |          |                   |        |  |  |
|                         |          |           | 54      | 3        | 1         | 348                 | 5               | 58       | 68        | 131                    | 893     | 921      | 3,395     | 696           | 54       | 59                |        |  |  |
| 3                       |          |           | 7       | 4        | 4         | 19                  | 3               | 33       | 38        | 50                     | 37      | 151      | 70        | 112           | 50       | 119               |        |  |  |
| 2                       | 1        | 2         |         |          |           |                     |                 | 1        | 3         |                        |         |          |           |               |          |                   |        |  |  |
|                         |          |           |         |          |           | 2                   |                 | 2        | 1         | 1                      | 93      | 19       | 24        | 11            | 1        |                   |        |  |  |
| 16                      | 5        | 1         | 116     | 58       | 74        | 21                  | 12              | 23       | 20        | 219                    | 180     | 29       | 230       | 34            | 82       | 54                |        |  |  |
|                         | 1        |           | 2       |          |           | 1                   |                 |          |           | 22                     | 5       | 10       | 13        | 5             | 1        |                   |        |  |  |
|                         |          |           |         |          |           |                     |                 |          | 4         |                        |         |          |           | 4             |          |                   |        |  |  |
| 975                     | 7        | 33        | 1       |          |           |                     | 90              | 29       | 111       | 11                     | 146     | 180      | 9         |               | 2        | 1,539             |        |  |  |
| 17                      | 10       | 13        |         |          |           | 19                  | 15              | 20       | 13        | 12                     | 50      | 70       | 105       | 58            | 131      | 69                |        |  |  |
| 94                      | 23       | 8         | 29      | 8        | 18        | 85                  | 124             | 113      | 32        | 185                    | 859     | 106      | 369       | 160           | 99       | 52                |        |  |  |
| 63                      | 21       | 10        | 26      | 9        | 18        | 71                  | 26              | 46       | 51        | 72                     | 196     | 134      | 327       | 236           | 203      | 89                |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        |         |          | 1         |               |          |                   |        |  |  |
|                         |          |           | 1       |          |           | 1                   | 2               | 5        | 10        | 3                      |         | 3        | 7         | 39            | 21       | 1                 |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        |         | 8        |           |               |          |                   |        |  |  |
| 1,850                   | 1,108    | 672       | 372     | 212      | 314       | 2,795               | 757             | 1,082    | 1,947     | 1,934                  | 6,074   | 15,204   | 4,647     | 2,890         | 2,614    | 3,656             |        |  |  |
| 22                      | 10       | 4         | 30      | 12       | 11        | 32                  | 9               | 12       | 6         | 27                     | 65      | 123      | 81        | 37            | 41       | 89                |        |  |  |
| 642                     | 432      | 278       | 228     | 64       | 93        | 1,411               | 147             | 262      | 303       | 468                    | 2,372   | 3,829    | 1,886     | 761           | 1,005    | 1,495             |        |  |  |
| 319                     | 149      | 91        | 27      | 12       | 15        | 602                 | 91              | 147      | 111       | 122                    | 778     | 1,310    | 694       | 154           | 298      | 253               |        |  |  |
| 15                      | 2        | 1         |         |          |           | 37                  | 10              | 5        | 5         | 41                     | 21      | 41       | 1         |               |          | 9                 |        |  |  |
| 1                       |          |           |         |          |           | 4                   | 1               | 4        | 2         | 7                      | 1       | 6        |           |               |          |                   |        |  |  |
| 2                       |          |           |         |          |           | 4                   | 13              | 8        |           | 3                      | 6       | 23       |           |               |          |                   |        |  |  |
| 5                       | 2        | 3         |         |          |           | 4                   | 6               | 1        | 3         | 1                      | 62      | 105      | 3         |               | 2        | 19                |        |  |  |
| 10                      | 2        | 6         |         |          |           | 9                   | 1               | 5        | 4         | 2                      | 97      | 30       | 19        | 3             |          |                   |        |  |  |
| 44                      | 68       | 102       | 3       | 1        |           | 64                  | 9               | 33       | 46        | 43                     | 628     | 427      | 292       | 35            | 4        | 15                |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        | 1       | 1        |           |               |          |                   |        |  |  |
| 3                       | 2        | 5         |         |          |           | 1                   |                 |          | 1         |                        | 16      | 8        |           |               |          |                   |        |  |  |
|                         | 1        | 2         |         |          |           | 2                   |                 |          |           |                        | 7       | 7        |           |               |          |                   |        |  |  |
| 33                      | 7        | 5         | 77      | 2        | 5         | 93                  | 23              | 166      | 160       | 161                    | 1,676   | 1,712    | 89        | 8             | 124      | 458               |        |  |  |
| 63                      | 12       |           |         |          |           | 3                   | 32              | 107      | 22        | 1                      | 5       | 2        | 1         |               | 13       | 473               |        |  |  |
| 43                      | 3        |           | 70      | 29       | 18        | 226                 | 11              | 56       | 67        | 1,894                  | 66      | 66       | 24        | 3             | 12       | 43                |        |  |  |
| 5                       | 2        |           | 3       |          |           | 4                   | 3               | 9        | 9         | 2                      | 2       | 6        | 5         | 1             | 8        | 41                |        |  |  |
|                         |          |           |         |          |           | 1                   | 1               |          |           |                        | 1       | 1        |           |               |          | 1                 |        |  |  |
|                         |          |           |         |          |           | 1                   | 1               | 1        | 2         | 18                     | 22      | 16       | 11        | 3             | 1        | 5                 |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        | 17      | 13       | 11        | 1             |          |                   |        |  |  |
|                         |          |           | 2       |          |           |                     |                 |          | 2         | 2                      | 1       |          |           |               |          |                   |        |  |  |
|                         | 2        |           | 21      | 5        | 7         | 11                  |                 | 5        | 3         | 31                     | 86      | 38       | 54        | 26            | 17       | 3                 |        |  |  |
|                         |          |           |         |          |           |                     |                 |          |           |                        | 1       |          |           |               |          |                   |        |  |  |
| 4                       | 5        | 5         |         |          |           | 16                  | 4               | 17       | 20        |                        | 154     | 33       | 30        | 58            | 3        |                   |        |  |  |
| 31                      | 22       | 29        | 47      | 3        | 5         | 170                 | 15              | 116      | 224       | 201                    | 727     | 562      | 970       | 706           | 211      | 170               |        |  |  |
| 12                      |          |           | 40      | 8        | 6         | 84                  |                 | 7        | 22        | 4                      | 65      | 483      | 20        | 10            | 33       | 54                |        |  |  |
| 5                       | 2        | 5         | 2       |          |           |                     | 5               |          |           | 3                      | 21      | 7        | 1         |               |          |                   |        |  |  |
| 8                       | 3        | 1         | 1       |          |           | 8                   | 6               | 6        | 4         | 1                      | 44      | 14       | 35        | 6             | 8        | 21                |        |  |  |
|                         |          |           |         |          |           |                     | 5               | 5        | 20        | 29                     |         |          | 1         |               |          | 1                 |        |  |  |
| 6                       | 1        |           |         |          |           | 28                  | 1               | 4        | 4         | 12                     | 30      | 25       | 36        | 22            | 24       | 11                |        |  |  |
| 2                       |          |           |         |          |           | 5                   |                 |          |           |                        | 3       |          | 28        | 1             | 3        |                   |        |  |  |
| 7                       | 2        | 1         | 20      | 3        | 9         | 130                 | 3               | 15       | 29        | 14                     | 85      | 338      | 274       | 153           | 133      | 138               |        |  |  |
| 7                       | 4        |           | 11      |          |           | 73                  | 5               | 18       | 9         | 45                     | 59      | 119      | 114       | 148           | 152      | 115               |        |  |  |
| 4                       | 1        |           | 3       |          |           | 9                   | 1               | 4        | 8         | 6                      | 58      | 147      |           |               | 1        | 21                |        |  |  |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals

|                             | SEX.   |          |           |         | TRADE OR                                 |          |           |                       |          |           |            |          |           |
|-----------------------------|--------|----------|-----------|---------|--|----------|-----------|-----------------------|----------|-----------|------------|----------|-----------|
|                             | Males. | Females. | Children. | Totals. | Farmers or<br>Farm Labour-<br>ers Class. |          |           | General<br>Labourers. |          |           | Mechanics. |          |           |
|                             |        |          |           |         | Males.                                   | Females. | Children. | Males.                | Females. | Children. | Males.     | Females. | Children. |
| Armenian . . . . .          | 44     | 23       | 12        | 79      | 9  | 4        | 4         | 22                    | 4        | 5         | 10         | 4        | 2         |
| Egyptian . . . . .          | 2      |          |           | 2       |  |          |           | 1                     |          |           |            |          |           |
| Syrian . . . . .            | 120    | 41       | 28        | 189     | 41                                       | 2        | 4         | 37                    | 5        | 7         | 13         | 5        | 5         |
| Arabian . . . . .           | 2      | 2        |           | 4       |  |          |           | 1                     | 1        |           |            |          |           |
| U. S. A. citizens . . . . . | 56     | 29       | 9         | 94      | 6  | 2        | 1         | 15                    | 1        | 1         | 15         | 5        |           |
| Negro . . . . .             | 49     | 22       | 2         | 73      | 7  | 1        | 1         | 13                    | 1        |           | 15         | 1        |           |
| Hindoo . . . . .            | 5      | 1        |           | 6       |  |          |           |                       |          |           | 1          |          |           |
| Totals . . . . .            | 46,337 | 22,898   | 17,841    | 87,076  | 16,489                                   | 4,253    | 4,902     | 13,809                | 1,997    | 2,573     | 8,909      | 5,090    | 4,939     |

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V.

for Canada at Ocean Ports, for the Fiscal Year ending March 31, 1909—*Con.*

| OCCUPATION.             |          |           |         |          |           |                  |                 |          |           | DESTINATION.           |         |          |           |               |          |                   |        |
|-------------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|-----------|------------------------|---------|----------|-----------|---------------|----------|-------------------|--------|
| Clerks,<br>Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |           | Maritime<br>Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. | Yukon. |
| Males.                  | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children. |                        |         |          |           |               |          |                   |        |
| 2                       | 4        | 1         |         |          |           | 7                | 1               |          |           | 6                      | 18      | 50       |           |               | 5        |                   |        |
| 1                       |          |           |         |          |           |                  |                 |          |           | 1                      | 1       | 1        |           |               |          |                   |        |
| 24                      | 18       | 7         | 1       |          |           | 6                | 4               | 5        | 5         | 62                     | 82      | 35       | 4         |               |          | 6                 |        |
| 1                       |          |           |         |          |           |                  |                 | 1        |           | 1                      | 2       | 1        |           |               |          |                   |        |
| 11                      | 10       | 6         | 2       |          |           | 5                | 7               | 6        | 1         | 12                     | 31      | 12       | 11        | 3             | 2        | 23                |        |
| 13                      |          |           |         |          |           | 19               | 1               |          | 1         | 43                     | 10      | 17       | 2         |               |          | 1                 |        |
| 4                       |          |           |         |          |           |                  |                 | 1        |           |                        | 2       | 3        | 1         |               |          |                   |        |
| 4,402                   | 1,960    | 1,302     | 1,264   | 454      | 635       | 6,615            | 1,464           | 2,529    | 3,490     | 6,144                  | 16,882  | 27,020   | 14,930    | 6,655         | 6,100    | 9,311             |        |

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## PORT OF NORTH SYDNEY.

For the fiscal year 1908-9, there arrived at the port of North Sydney 7,292 passengers, of whom 2,720 travelled saloon and 4,572 steerage. Of the saloon passengers, 1,858 were destined to Canada and 862 to the United States. Of the steerage passengers, 3,352 were for Canada and 1,220 for the United States. Included in the steerage passengers for Canada were 795 returned Canadians and 167 tourists, leaving the immigration proper at 2,390 souls, a decrease as compared with the preceding fiscal year of 1,332 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of North Sydney, for the Fiscal Year ending March 31, 1909.

|                       | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|-----------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                       | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| Australian .....      | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Austrian .....        | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| French .....          | 84      | 52       | 18        | 154     | 5              | 8        | 5         | 18      | 89                        | 60       | 23        | 172     |
| German .....          | 3       |          |           | 3       | 5              |          |           | 5       | 8                         |          |           | 8       |
| English .....         | 116     | 33       | 2         | 151     | 16             | 2        |           | 18      | 132                       | 35       | 2         | 169     |
| Welsh .....           | 5       | 1        |           | 6       | 3              |          |           | 3       | 8                         | 1        |           | 9       |
| Scotch .....          | 37      | 7        |           | 44      | 8              | 1        |           | 9       | 45                        | 8        |           | 53      |
| Irish .....           | 8       |          |           | 8       | 1              | 1        |           | 2       | 9                         | 1        |           | 10      |
| West Indian .....     | 3       |          |           | 3       | 1              |          |           | 1       | 4                         |          |           | 4       |
| Jamaican .....        | 1       |          |           | 1       | 1              |          |           | 1       | 2                         |          |           | 2       |
| Greek .....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Italian .....         | 4       |          |           | 4       |                |          |           |         | 4                         |          |           | 4       |
| Newfoundland .....    | 301     | 188      | 20        | 509     | 114            | 115      | 3         | 232     | 415                       | 303      | 23        | 741     |
| New Zealand .....     | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Russian .....         | 2       |          |           | 2       | 1              | 2        |           | 3       | 3                         | 2        |           | 5       |
| Spanish .....         |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Syrian .....          |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| U.S.A. citizens ..... | 39      | 12       |           | 51      | 421            | 128      | 12        | 561     | 460                       | 140      | 12        | 612     |
| Canadian .....        | 652     | 217      | 26        | 895     | 5              |          |           | 5       | 657                       | 217      | 26        | 900     |
| Tourist .....         | 18      | 3        |           | 21      | 1              | 2        |           | 3       | 19                        | 5        |           | 24      |
| Totals .....          | 1,278   | 514      | 66        | 1,858   | 583            | 259      | 20        | 862     | 1,861                     | 773      | 86        | 2,720   |



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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of North Sydney,  
for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| Austrian.....          | 3       |          |           | 3       | 1              |          |           | 1       | 4                         |          |           | 4       |
| Belgian.....           | 2       | 2        | 1         | 5       |                |          |           |         | 2                         | 2        | 1         | 5       |
| Bulgarian.....         | 22      |          |           | 22      | 6              |          |           | 6       | 28                        |          |           | 28      |
| Chinese.....           | 13      |          |           | 13      |                |          |           |         | 13                        |          |           | 13      |
| French.....            | 82      | 26       | 26        | 134     | 2              | 4        |           | 6       | 84                        | 30       | 26        | 140     |
| German.....            | 10      |          |           | 10      | 6              |          |           | 6       | 16                        |          |           | 16      |
| English.....           | 46      | 6        | 2         | 54      | 5              |          |           | 5       | 51                        | 6        | 2         | 59      |
| Welsh.....             | 4       |          |           | 4       | 5              |          |           | 5       | 9                         |          |           | 9       |
| Scotch.....            | 8       | 1        | 2         | 11      | 2              |          |           | 2       | 10                        | 1        | 2         | 13      |
| Irish.....             | 2       |          |           | 2       | 1              |          |           | 1       | 3                         |          |           | 3       |
| West Indian.....       | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Italian.....           | 1       |          |           | 1       | 1              |          |           | 1       | 2                         |          |           | 2       |
| Japanese.....          | 2       |          |           | 2       | 1              |          |           | 1       | 3                         |          |           | 3       |
| Newfoundland.....      | 1,592   | 368      | 126       | 2,086   | 519            | 370      | 33        | 922     | 2,111                     | 738      | 159       | 3,008   |
| Portuguese.....        |         |          |           |         | 5              |          |           | 5       | 5                         |          |           | 5       |
| Russian.....           | 5       |          |           | 5       | 1              |          |           | 1       | 6                         |          |           | 6       |
| Danish.....            | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Swedish.....           | 7       | 3        | 1         | 11      | 1              |          |           | 1       | 8                         | 3        | 1         | 12      |
| Norwegian.....         | 9       |          |           | 9       | 1              |          |           | 1       | 10                        |          |           | 10      |
| Syrian.....            | 4       | 2        | 1         | 7       | 8              | 3        | 3         | 14      | 12                        | 5        | 4         | 21      |
| U.S.A. citizens.....   | 7       | 1        |           | 8       | 39             | 4        | 13        | 56      | 46                        | 5        | 13        | 64      |
| Total immigration..... | 1,822   | 409      | 159       | 2,390   | 604            | 381      | 49        | 1,034   | 2,426                     | 790      | 208       | 3,424   |
| Returned Canadian..... | 545     | 212      | 38        | 795     |                |          |           |         | 545                       | 212      | 38        | 795     |
| Tourist.....           | 83      | 77       | 7         | 167     | 13             | 150      | 23        | 186     | 96                        | 227      | 30        | 353     |
| Totals.....            | 2,450   | 698      | 204       | 3,352   | 617            | 531      | 72        | 1,220   | 3,067                     | 1,229    | 276       | 4,572   |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of North Sydney, for the Fiscal Year ending March 31, 1909.

|                      | April. | May. | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|----------------------|--------|------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| Austrian.....        |        |      |       |       | 2       |            |          |           |           |          |           | 1      | 3       |
| Belgian.....         |        | 5    |       |       |         |            |          |           |           |          |           |        | 5       |
| Bulgarian.....       |        | 11   |       |       | 9       | 2          |          |           |           |          |           |        | 22      |
| Chinese.....         |        |      |       |       |         | 10         |          | 2         |           |          |           | 1      | 13      |
| French.....          |        | 21   | 16    | 6     | 7       | 13         | 35       | 20        | 12        | 1        | 1         | 2      | 134     |
| German.....          | 1      |      |       | 3     |         | 2          |          |           | 3         |          |           | 1      | 10      |
| English.....         | 3      | 9    | 22    | 4     | 2       | 4          | 8        | 1         | 1         |          |           |        | 54      |
| Welsh.....           |        |      |       |       |         |            |          | 4         |           |          |           |        | 4       |
| Scotch.....          | 2      | 1    | 4     |       | 2       |            | 2        |           |           |          |           |        | 11      |
| Irish.....           |        |      | 1     |       |         |            |          |           | 1         |          |           |        | 2       |
| West Indian.....     |        |      |       |       |         |            |          |           | 1         |          |           |        | 1       |
| Italian.....         |        |      |       |       |         |            |          |           |           |          |           | 1      | 1       |
| Japanese.....        |        |      |       |       |         | 2          |          |           |           |          |           |        | 2       |
| Newfoundland.....    | 297    | 305  | 181   | 112   | 193     | 220        | 173      | 217       | 83        | 62       | 37        | 206    | 2,086   |
| Russian.....         |        |      |       |       |         |            |          |           | 2         | 3        |           |        | 5       |
| Danish.....          | 1      |      |       |       |         |            | 1        |           |           |          |           |        | 2       |
| Swedish.....         |        |      | 3     |       |         |            | 1        |           | 1         |          |           | 6      | 11      |
| Norwegian.....       | 1      | 2    | 2     |       |         |            | 3        | 1         |           |          |           |        | 9       |
| Syrian.....          | 2      |      | 3     |       |         | 1          |          |           |           |          |           | 1      | 7       |
| U.S.A. citizens..... | 1      | 1    |       | 4     | 1       |            |          |           |           | 1        |           |        | 8       |
| Totals.....          | 308    | 355  | 232   | 129   | 216     | 254        | 223      | 245       | 104       | 67       | 39        | 218    | 2,390   |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Destination, at the Port of North Sydney, for the Fiscal Year ending March 31, 1909.

|                         | April.     | May.       | June.      | July.      | August.    | September. | October.   | November.  | December.  | January.  | February. | March.     | Totals.      |
|-------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|------------|--------------|
| Agriculturists.....     | 1          | 1          | 3          | 3          | 15         | 8          | 2          | 3          | 3          | 3         | 1         | 1          | 44           |
| General labourers.....  | 242        | 213        | 118        | 60         | 115        | 126        | 157        | 181        | 54         | 42        | 24        | 170        | 1,502        |
| Mechanics.....          | 31         | 47         | 27         | 9          | 29         | 34         | 17         | 6          | 24         | 4         | 1         | 24         | 252          |
| Clerks.....             | 3          | 7          | 9          | 4          | 7          | 7          | 2          | 4          | 5          | 4         | 1         | 5          | 58           |
| Miners.....             | 9          | 17         | 34         | 19         | 11         | 29         | 3          | 9          | 3          | 5         | 8         | 4          | 151          |
| Female servants.....    | 20         | 45         | 26         | 16         | 20         | 23         | 34         | 27         | 12         | 2         | 2         | 12         | 239          |
| Not classed.....        | 2          | 25         | 15         | 18         | 19         | 27         | 8          | 15         | 3          | 7         | 3         | 2          | 144          |
| <b>Totals.....</b>      | <b>308</b> | <b>355</b> | <b>232</b> | <b>129</b> | <b>216</b> | <b>254</b> | <b>223</b> | <b>245</b> | <b>104</b> | <b>67</b> | <b>39</b> | <b>218</b> | <b>2,390</b> |
| Maritime Provinces..... | 265        | 298        | 213        | 115        | 191        | 214        | 212        | 234        | 95         | 65        | 34        | 189        | 2,125        |
| Quebec.....             | 17         | 26         | 4          | 8          | 7          | 23         | 4          | 6          | 4          | 1         | 1         | 6          | 106          |
| Ontario.....            | 8          | 20         | 10         | 5          | 2          | 4          | 3          | 5          | 1          | 1         | 1         | 9          | 68           |
| Manitoba.....           | 2          | 4          | 4          | 1          | 14         | 1          | 1          | 1          | 2          | 1         | 1         | 7          | 35           |
| Saskatchewan.....       | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1         | 1         | 1          | 1            |
| Alberta.....            | 1          | 2          | 1          | 1          | 1          | 4          | 1          | 1          | 1          | 1         | 1         | 5          | 12           |
| British Columbia.....   | 16         | 5          | 1          | 1          | 1          | 8          | 4          | 1          | 3          | 1         | 4         | 1          | 43           |
| <b>Totals.....</b>      | <b>308</b> | <b>355</b> | <b>232</b> | <b>129</b> | <b>216</b> | <b>254</b> | <b>223</b> | <b>245</b> | <b>104</b> | <b>67</b> | <b>39</b> | <b>218</b> | <b>2,390</b> |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals for

|                      | SEX.   |          |           |         | TRADE OR                            |          |           |                    |          |           |            |          |           |
|----------------------|--------|----------|-----------|---------|-------------------------------------|----------|-----------|--------------------|----------|-----------|------------|----------|-----------|
|                      |        |          |           |         | Farmers or Farm<br>Labourers Class. |          |           | General Labourers. |          |           | Mechanics. |          |           |
|                      | Males. | Females. | Children. | Totals. | Males.                              | Females. | Children. | Males.             | Females. | Children. | Males.     | Females. | Children. |
| Austrian.....        | 3      |          |           | 3       |                                     |          |           | 3                  |          |           |            |          |           |
| Belgian.....         | 2      | 2        | 1         | 5       |                                     |          |           | 2                  | 2        | 1         |            |          |           |
| Bulgarian.....       | 22     |          |           | 22      |                                     |          |           | 20                 |          |           |            |          |           |
| Chinese.....         | 13     |          |           | 13      | 1                                   |          |           | 12                 |          |           |            |          |           |
| French.....          | 82     | 26       | 26        | 134     | 3                                   |          |           | 62                 | 4        | 9         | 12         | 7        | 10        |
| German.....          | 10     |          |           | 10      |                                     |          |           |                    |          |           |            |          |           |
| English.....         | 46     | 6        | 2         | 54      |                                     |          |           | 17                 | 1        |           | 7          |          |           |
| Welsh.....           | 4      |          |           | 4       | 1                                   |          |           |                    |          |           |            |          |           |
| Scotch.....          | 2      | 1        | 2         | 11      |                                     |          |           | 1                  |          |           | 5          |          |           |
| Irish.....           | 1      |          |           | 2       |                                     |          |           | 1                  |          |           | 1          |          |           |
| West Indian.....     | 1      |          |           | 1       |                                     |          |           | 1                  |          |           |            |          |           |
| Italian.....         | 1      |          |           | 1       |                                     |          |           | 1                  |          |           |            |          |           |
| Japanese.....        | 2      |          |           | 2       |                                     |          |           | 2                  |          |           |            |          |           |
| Newfoundland.....    | 1,592  | 368      | 126       | 2,086   | 32                                  | 1        | 4         | 1,280              | 33       | 24        | 160        | 25       | 16        |
| Russian.....         | 5      |          |           | 5       | 1                                   |          |           | 1                  |          |           |            |          |           |
| Danish.....          | 2      |          |           | 2       |                                     |          |           |                    |          |           |            |          |           |
| Swedish.....         | 7      | 3        | 1         | 11      |                                     |          |           | 3                  | 2        |           | 4          | 1        | 1         |
| Norwegian.....       | 9      |          |           | 9       | 1                                   |          |           | 6                  |          |           | 1          |          |           |
| Syrian.....          | 4      | 2        | 1         | 7       |                                     |          |           | 1                  |          |           | 1          |          |           |
| U.S.A. citizens..... | 7      | 1        |           | 8       |                                     |          |           | 4                  |          |           | 1          |          |           |
| Totals.....          | 1,822  | 409      | 159       | 2,390   | 39                                  | 1        | 4         | 1,426              | 42       | 34        | 192        | 33       | 27        |

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V.  
Canada at the Port of North Sydney, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.          |          |           |         |          |           |                  |                 |          |           | DESTINATION.        |         |          |           |               |          |                   |
|----------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|-----------|---------------------|---------|----------|-----------|---------------|----------|-------------------|
| Clerks, Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |           | Maritime Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. |
| Males.               | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children. |                     |         |          |           |               |          |                   |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 1                   | 2       | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | 2       | .....    | .....     | .....            | .....           | .....    | .....     | 5                   | .....   | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 23                  | .....   | .....    | .....     | .....         | .....    |                   |
| 3                    | .....    | .....     | 1       | .....    | .....     | 11               | 1               | 4        | 7         | 1                   | 10      | 2        | .....     | .....         | .....    |                   |
| 12                   | .....    | .....     | 1       | .....    | .....     | .....            | .....           | .....    | .....     | 116                 | 18      | .....    | .....     | .....         | .....    |                   |
| 4                    | .....    | .....     | 17      | 3        | 2         | 2                | 1               | .....    | .....     | 10                  | .....   | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | 3       | .....    | .....     | .....            | .....           | .....    | .....     | 49                  | 5       | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | 2       | 1        | 2         | .....            | .....           | .....    | .....     | 4                   | .....   | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 9                   | 1       | 1        | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 1                   | .....   | .....    | .....     | .....         | .....    |                   |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 1                   | .....   | .....    | .....     | .....         | .....    |                   |
| 42                   | 2        | .....     | 70      | 29       | 18        | 225              | 8               | 53       | 64        | 1,874               | 66      | 66       | 24        | 1             | 12       | 43                |
| 2                    | .....    | .....     | .....   | .....    | .....     | .....            | 1               | .....    | .....     | 5                   | .....   | .....    | .....     | .....         | .....    | .....             |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 13                  | .....   | .....    | .....     | .....         | .....    | .....             |
| 1                    | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 19                  | .....   | .....    | 9         | .....         | .....    | .....             |
| 2                    | .....    | .....     | .....   | .....    | .....     | .....            | .....           | 2        | 1         | 7                   | 1       | .....    | 1         | .....         | .....    | .....             |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | 1               | .....    | .....     | 6                   | 1       | .....    | .....     | .....         | .....    | .....             |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 2                   | .....   | .....    | .....     | .....         | .....    | .....             |
| .....                | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | 2                   | .....   | .....    | .....     | .....         | .....    | .....             |
| 56                   | 2        | .....     | 96      | 33       | 22        | 239              | 13              | 59       | 72        | 2,125               | 106     | 68       | 35        | 1             | 12       | 43                |

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## PORT OF HALIFAX.

For the fiscal year 1908-9, there arrived at the port of Halifax 21,528 passengers, of whom 1,829 travelled saloon and 19,699 steerage. Of the saloon passengers, 1,803 were destined to Canada, and 21 to the United States. Of the steerage passengers, 17,096 were for Canada and 2,603 for the United States. Included in the steerage passengers for Canada were 3,419 returned Canadians and 298 tourists, leaving the immigration proper at 13,379 souls, a decrease as compared with the preceding fiscal year of 14,910 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of Halifax, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| Australian.....        | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Austrian.....          | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Chinese.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| French.....            | 6       | 3        |           | 9       | 1              |          |           | 1       | 7                         | 3        |           | 10      |
| German.....            | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| English.....           | 272     | 108      | 22        | 402     | 4              | 1        | 3         | 8       | 276                       | 109      | 25        | 410     |
| Welsh.....             | 2       | 1        |           | 3       |                |          |           |         | 2                         | 1        |           | 3       |
| Scotch.....            | 56      | 16       | 4         | 76      |                | 1        |           | 1       | 56                        | 17       | 4         | 77      |
| Irish.....             | 8       | 7        | 2         | 17      | 2              | 2        |           | 4       | 10                        | 9        | 2         | 21      |
| West Indian.....       | 4       | 3        |           | 7       | 1              | 1        |           | 2       | 5                         | 4        |           | 9       |
| Bermudian.....         | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Italian.....           | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Newfoundland.....      | 10      | 19       | 1         | 30      | 1              |          |           | 1       | 11                        | 19       | 1         | 31      |
| Danish.....            |         | 1        | 3         | 4       |                |          |           |         |                           | 1        | 3         | 4       |
| Swedish.....           | 2       | 1        |           | 3       |                |          |           |         | 2                         | 1        |           | 3       |
| Norwegian.....         | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Syrian.....            | 3       |          |           | 3       |                |          |           |         | 3                         |          |           | 3       |
| U. S. A. citizens..... | 17      | 3        |           | 20      | 3              | 1        |           | 4       | 20                        | 4        |           | 24      |
| Canadian.....          | 277     | 170      | 48        | 495     |                |          |           |         | 277                       | 170      | 48        | 495     |
| Tourist.....           | 424     | 265      | 41        | 730     |                |          |           |         | 424                       | 265      | 41        | 730     |
| Totals.....            | 1,090   | 597      | 121       | 1,808   | 12             | 6        | 3         | 21      | 1,102                     | 603      | 124       | 1,829   |

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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of Halifax, for the Fiscal Year ending March 31, 1909.

|                         | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|-------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                         | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....     | 4       | 4        |           | 8       |                |          |           |         | 4                         | 4        |           | 8       |
| Australian.....         | 3       | 1        |           | 4       |                |          |           |         | 3                         | 1        |           | 4       |
| Austrian, N. E. S.....  | 24      | 17       | 25        | 66      | 125            | 11       | 3         | 139     | 149                       | 28       | 28        | 205     |
| Bohemian.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Bukowinian.....         | 259     | 25       | 32        | 316     |                |          |           |         | 259                       | 25       | 32        | 316     |
| Galician.....           | 1,022   | 264      | 261       | 1,547   | 1              |          |           | 1       | 1,023                     | 264      | 261       | 1,548   |
| Hungarian, N. E. S..... | 17      | 7        | 7         | 31      | 5              |          |           | 5       | 22                        | 7        | 7         | 36      |
| Ruthenian.....          | 11      | 5        | 11        | 27      |                |          |           |         | 11                        | 6        | 11        | 27      |
| Belgian.....            | 95      | 52       | 68        | 215     | 10             | 4        | 7         | 21      | 105                       | 56       | 75        | 236     |
| Bulgarian.....          | 3       | 1        |           | 4       | 1              |          | 1         | 2       | 4                         | 1        | 1         | 6       |
| Chinese.....            | 2       |          |           | 2       |                |          |           |         |                           |          |           | 2       |
| Dutch.....              | 60      | 22       | 15        | 97      | 11             | 5        | 1         | 17      | 71                        | 27       | 16        | 114     |
| French.....             | 279     | 63       | 54        | 396     | 11             | 2        | 4         | 17      | 290                       | 65       | 58        | 413     |
| German, N. E. S.....    | 89      | 47       | 56        | 192     | 14             | 5        |           | 19      | 103                       | 52       | 56        | 211     |
| Alsatian.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Prussian.....           | 14      | 10       | 24        | 48      | 1              |          | 2         | 3       | 15                        | 10       | 26        | 51      |
| English.....            | 3,404   | 1,425    | 1,341     | 6,173   | 138            | 55       | 33        | 226     | 3,542                     | 1,480    | 1,377     | 6,399   |
| Welsh.....              | 35      | 21       | 9         | 65      | 3              | 2        | 1         | 6       | 38                        | 23       | 10        | 71      |
| Scotch.....             | 1,063   | 519      | 365       | 1,947   | 28             | 8        | 8         | 44      | 1,091                     | 527      | 373       | 1,991   |
| Irish.....              | 211     | 96       | 49        | 356     | 10             | 4        | 4         | 18      | 221                       | 100      | 53        | 374     |
| West Indian.....        | 13      | 11       |           | 24      | 12             |          |           | 12      | 25                        | 11       |           | 36      |
| Bermudian.....          |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Jamaican.....           | 5       | 3        |           | 8       |                |          |           |         | 5                         | 3        |           | 8       |
| Creek.....              | 27      | 1        | 1         | 29      | 67             |          | 6         | 73      | 94                        | 1        | 7         | 102     |
| Hebrew, N. E. S.....    | 4       | 8        | 8         | 20      | 7              | 2        | 4         | 13      | 11                        | 10       | 12        | 33      |
| "    Russian.....       | 117     | 78       | 76        | 271     | 16             | 15       | 11        | 42      | 133                       | 93       | 87        | 313     |
| "    Polish.....        | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| "    Austrian.....      | 2       | 1        | 1         | 4       |                |          |           |         | 2                         | 1        | 1         | 4       |
| "    German.....        | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Italian.....            | 133     | 7        | 4         | 144     | 12             | 3        | 4         | 19      | 145                       | 10       | 8         | 163     |
| Japanese.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Newfoundland.....       | 7       | 6        | 2         | 15      | 18             | 2        |           | 20      | 25                        | 8        | 2         | 35      |
| New Zealand.....        | 3       |          |           | 3       |                |          |           |         | 3                         |          |           | 3       |
| Portuguese.....         |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Polish, N. E. S.....    | 16      | 1        |           | 17      | 11             | 1        |           | 12      | 27                        | 2        |           | 29      |
| "    Austrian.....      |         |          |           | 2       |                |          |           | 2       | 2                         |          |           | 2       |
| "    German.....        | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| "    Russian.....       | 21      | 3        | 4         | 28      | 2              |          |           | 2       | 23                        | 3        | 4         | 30      |
| Roumanian.....          | 20      | 9        | 8         | 37      | 5              | 1        |           | 6       | 25                        | 10       | 8         | 43      |
| Russian, N. E. S.....   | 367     | 84       | 120       | 571     | 219            | 93       | 89        | 401     | 586                       | 177      | 209       | 972     |
| Finnish.....            | 119     | 19       | 2         | 140     | 637            | 112      | 60        | 809     | 756                       | 131      | 62        | 949     |
| Spanish.....            | 3       | 1        |           | 4       | 1              |          |           | 1       | 4                         | 1        |           | 5       |
| Swiss.....              | 22      | 4        | 4         | 30      | 3              | 3        |           | 6       | 25                        | 7        | 4         | 36      |
| Servian.....            | 5       | 5        | 20        | 30      | 6              | 5        | 5         | 16      | 11                        | 10       | 25        | 46      |
| Danish.....             | 18      | 5        |           | 23      | 26             | 4        | 1         | 31      | 44                        | 9        | 1         | 54      |
| Icelandic.....          | 2       | 1        | 1         | 4       |                |          |           |         | 2                         | 1        | 1         | 4       |
| Swedish.....            | 121     | 24       | 20        | 165     | 107            | 39       | 26        | 172     | 228                       | 63       | 46        | 337     |
| Norwegian.....          | 68      | 18       | 8         | 94      | 140            | 30       | 19        | 189     | 208                       | 48       | 27        | 283     |
| Turkish.....            | 3       | 1        |           | 4       | 21             | 1        |           | 22      | 24                        | 2        |           | 26      |
| Armenian.....           | 33      | 18       | 8         | 59      | 78             | 31       | 23        | 132     | 111                       | 49       | 31        | 191     |
| Syrian.....             | 59      | 16       | 15        | 90      | 12             | 7        | 3         | 22      | 71                        | 23       | 18        | 112     |
| Arabian.....            |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| U. S. A. citizens.....  | 7       | 3        | 1         | 11      | 51             | 18       | 11        | 80      | 58                        | 21       | 12        | 91      |
| Negro.....              | 41      | 7        | 1         | 49      |                |          |           |         | 41                        | 7        | 1         | 49      |
| Hindoo.....             |         |          |           |         | 1              |          |           | 1       |                           |          |           | 1       |
| Total immigration.....  | 7,839   | 2,916    | 2,624     | 13,379  | 1,812          | 463      | 326       | 2,601   | 9,651                     | 3,379    | 2,950     | 15,980  |
| Returned Canadians..... | 2,694   | 493      | 232       | 3,419   |                |          |           |         | 2,694                     | 493      | 232       | 3,419   |
| Tourist.....            | 206     | 77       | 15        | 298     |                |          |           |         | 208                       | 77       | 15        | 300     |
| Totals.....             | 10,739  | 3,486    | 2,871     | 17,096  | 1,814          | 463      | 326       | 2,603   | 12,553                    | 3,949    | 3,197     | 19,699  |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of Halifax, for the Fiscal Year ending March 31, 1909.

|                         | April. | May.  | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|-------------------------|--------|-------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| African, South .....    | 2      |       |       |       |         |            |          | 1         | 4         | 1        |           |        | 8       |
| Australian .....        | 3      |       |       |       |         |            |          |           | 1         |          |           |        | 4       |
| Austrian, N.E.S. ....   | 6      | 34    | 11    | 3     |         | 1          |          | 1         |           | 2        | 4         | 4      | 66      |
| Bohemian .....          | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Bukowinian .....        | 28     | 250   | 37    |       |         |            |          |           |           |          | 1         |        | 316     |
| Galician .....          | 462    | 801   | 280   | 1     |         |            |          | 1         |           |          | 2         |        | 1,547   |
| Hungarian, N.E.S. ....  | 10     |       | 11    | 5     |         |            |          |           | 4         |          |           | 1      | 31      |
| Ruthenian.....          |        | 27    |       |       |         |            |          |           |           |          |           |        | 27      |
| Belgian.....            | 61     | 16    | 7     | 18    | 1       | 8          | 5        | 3         | 7         | 14       | 14        | 61     | 215     |
| Bulgarian .....         | 1      |       | 2     |       |         |            |          |           |           |          |           |        | 4       |
| Chinese .....           |        |       |       | 2     |         |            |          |           |           |          |           |        | 2       |
| Dutch .....             | 44     |       | 1     |       | 1       |            |          | 1         | 9         |          | 4         |        | 37      |
| French .....            | 199    |       | 2     | 1     |         | 8          |          | 2         | 33        | 16       | 32        | 103    | 396     |
| German, N.E.S. ....     | 84     | 11    | 30    | 1     | 2       | 3          | 7        | 5         | 8         | 11       | 13        | 17     | 192     |
| Alsatian .....          | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Prussian .....          |        |       |       |       |         | 1          |          |           | 47        |          |           |        | 48      |
| English .....           | 3,700  | 189   | 45    | 44    | 69      | 40         | 63       | 134       | 255       | 133      | 301       | 1,200  | 6,173   |
| Welsh .....             | 38     | 3     |       |       | 1       |            | 1        | 6         | 1         | 1        | 1         |        | 13      |
| Scotch .....            | 1,070  | 9     | 14    | 40    | 15      | 13         | 8        | 26        | 136       | 90       | 104       | 422    | 1,947   |
| Irish .....             | 208    | 3     | 14    | 1     | 4       | 1          | 8        | 3         | 21        | 19       | 12        | 62     | 356     |
| West Indian .....       |        | 6     | 13    | 3     |         |            |          |           |           |          | 1         | 1      | 24      |
| Bermudian .....         |        |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Jamaican .....          |        |       |       | 4     |         |            | 2        | 2         |           |          |           |        | 8       |
| Greek .....             | 9      |       |       |       |         |            |          | 1         | 1         | 2        | 7         | 9      | 29      |
| Hebrew, N.E.S. ....     | 9      | 1     |       |       |         |            |          |           | 6         | 2        | 2         |        | 20      |
| " Russian .....         | 76     | 4     | 2     | 6     | 8       |            | 8        | 22        | 41        | 27       | 30        | 47     | 271     |
| " Polish .....          | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| " Austrian .....        | 4      |       |       |       |         |            |          |           |           |          |           |        | 4       |
| " German.....           | 2      |       |       |       |         |            |          |           |           |          |           |        | 2       |
| Italian .....           | 31     | 18    |       |       | 4       |            | 3        | 1         | 1         | 14       | 32        | 40     | 144     |
| Japanese .....          | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Newfoundland .....      | 2      | 1     | 2     | 1     |         |            | 4        | 1         |           | 1        |           |        | 3       |
| New Zealand .....       |        |       |       |       |         |            |          |           |           | 1        |           |        | 2       |
| Portuguese .....        | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Polish, N.E.S. ....     |        |       | 2     |       |         | 10         |          |           | 1         |          |           |        | 4       |
| " German .....          |        |       |       |       |         |            |          |           |           |          |           |        | 2       |
| " Russian .....         |        | 6     |       | 5     | 8       |            | 1        |           |           | 7        |           |        | 1       |
| Boumanian .....         | 15     | 9     | 4     | 1     |         |            |          |           | 2         |          |           |        | 6       |
| Russian, N.E.S. ....    | 237    | 44    | 49    | 56    | 1       |            |          | 3         | 31        | 40       | 28        | 82     | 571     |
| Finnish .....           | 13     |       |       |       |         |            | 1        | 5         | 24        | 11       | 34        | 52     | 140     |
| Spanish .....           |        |       |       |       | 1       |            |          | 1         |           | 2        |           |        | 4       |
| Swiss .....             | 2      |       |       |       | 1       |            |          |           | 1         | 2        |           |        | 24      |
| Servian .....           |        |       |       |       |         |            |          |           | 1         |          |           |        | 29      |
| Danish .....            | 11     |       |       |       |         |            |          |           |           |          | 7         |        | 5       |
| Icelandic.....          |        |       |       |       |         |            |          |           | 3         |          |           |        | 1       |
| Swedish .....           | 43     |       |       |       |         |            |          | 4         | 22        | 8        | 32        | 56     | 165     |
| Norwegian .....         | 21     |       | 1     |       |         | 3          |          |           | 11        | 1        | 21        | 36     | 94      |
| Turkish .....           | 1      | 2     |       | 1     |         |            |          |           |           |          |           |        | 4       |
| Armenian .....          | 21     | 2     | 5     | 10    |         |            |          |           | 13        |          |           |        | 8       |
| Syrian .....            | 8      | 3     | 1     | 6     | 33      |            |          | 1         | 12        | 13       | 10        | 3      | 90      |
| Arabian .....           |        |       |       |       |         |            |          |           | 1         |          |           |        | 1       |
| U. S. A. citizens ..... | 1      |       |       |       | 2       |            |          |           | 2         | 1        | 2         | 3      | 11      |
| Negro .....             | 34     |       | 11    |       | 3       |            |          |           | 1         |          |           |        | 49      |
| Totals .....            | 6,461  | 1,439 | 545   | 211   | 154     | 88         | 112      | 224       | 700       | 419      | 694       | 2,332  | 13,379  |



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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Designation, at the Port of Halifax, for the Fiscal Year ending March 31, 1909.

|                         | April. | May.  | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|-------------------------|--------|-------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| Agriculturists.....     | 3,215  | 874   | 316   | 58    | 29      | 11         | 13       | 52        | 228       | 113      | 235       | 1,288  | 6,432   |
| General labourers.....  | 708    | 180   | 75    | 40    | 39      | 9          | 13       | 29        | 106       | 67       | 103       | 292    | 1,661   |
| Mechanics.....          | 1,461  | 83    | 88    | 27    | 31      | 8          | 27       | 76        | 117       | 109      | 127       | 325    | 2,479   |
| Clerks.....             | 329    | 10    | 7     | 5     | 9       | 6          | 6        | 15        | 76        | 29       | 48        | 125    | 665     |
| Miners.....             | 191    | 50    | 28    | 52    | 31      | 42         | 23       | 19        | 56        | 33       | 28        | 29     | 582     |
| Female servants.....    | 333    | 70    | 23    | 15    | 9       | 9          | 9        | 19        | 61        | 39       | 54        | 167    | 799     |
| Not classed.....        | 224    | 172   | 8     | 14    | 6       | 12         | 21       | 14        | 56        | 29       | 99        | 106    | 761     |
| Totals.....             | 6,461  | 1,439 | 545   | 211   | 154     | 88         | 112      | 224       | 700       | 419      | 694       | 2,332  | 13,379  |
| Maritime Provinces..... | 636    | 302   | 137   | 122   | 137     | 86         | 94       | 86        | 126       | 83       | 75        | 245    | 2,133   |
| Quebec.....             | 667    | 182   | 12    | 17    | 6       | 7          | 32       | 94        | 83        | 200      | 245       | 1,545  |         |
| Ontario.....            | 2,369  | 205   | 56    | 25    | 7       | 3          | 65       | 223       | 105       | 213      | 700       | 3,971  |         |
| Manitoba.....           | 1,279  | 523   | 170   | 46    | 3       | 2          | 4        | 5         | 105       | 56       | 68        | 527    | 2,788   |
| Saskatchewan.....       | 555    | 133   | 83    | 1     | 1       | 1          | 18       | 70        | 43        | 37       | 258       | 1,199  |         |
| Alberta.....            | 376    | 85    | 69    | 1     | 1       | 1          | 16       | 38        | 20        | 44       | 201       | 845    |         |
| British Columbia.....   | 579    | 9     | 18    | 1     | 1       | 2          | 8        | 44        | 29        | 57       | 152       | 898    |         |
| Totals.....             | 6,461  | 1,439 | 545   | 211   | 154     | 88         | 112      | 224       | 700       | 419      | 694       | 2,332  | 13,379  |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals for

|                    | SEX.   |          |           | Totals. | TRADE OR OCCUPATION.             |          |           |                    |          |           |            |          |           |
|--------------------|--------|----------|-----------|---------|----------------------------------|----------|-----------|--------------------|----------|-----------|------------|----------|-----------|
|                    |        |          |           |         | Farmers or Farm Labourers Class. |          |           | General Labourers. |          |           | Mechanics. |          |           |
|                    | Males. | Females. | Children. |         | Males.                           | Females. | Children. | Males.             | Females. | Children. | Males.     | Females. | Children. |
| African, South.... | 4      | 4        |           | 8       | 2                                |          |           |                    |          |           |            | 1        |           |
| Australian....     | 3      | 1        |           | 4       | 1                                |          |           |                    |          |           |            |          |           |
| Austrian, N.E.S.   | 24     | 17       | 25        | 66      | 10                               | 4        | 6         | 2                  |          |           | 2          | 6        | 2         |
| Bohemian.....      | 1      |          |           | 1       |                                  |          |           |                    |          |           | 1          |          |           |
| Bukowinian....     | 259    | 25       | 32        | 316     | 164                              | 11       | 25        | 87                 | 3        | 1         | 7          | 1        | 1         |
| Galician.....      | 1,022  | 264      | 261       | 1,547   | 822                              | 162      | 238       | 136                | 12       | 6         | 60         | 9        | 9         |
| Hungarian, N.E.S.  | 17     | 7        | 7         | 31      | 5                                | 1        | 2         | 4                  | 1        | 1         | 4          | 2        |           |
| Ruthenian....      | 11     | 5        | 11        | 27      | 10                               | 2        | 7         | 1                  | 1        | 3         |            |          |           |
| Belgian.....       | 95     | 32       | 68        | 215     | 46                               | 17       | 22        |                    |          |           | 6          | 4        | 7         |
| Bulgarian.....     | 3      | 1        |           | 4       | 2                                | 1        |           | 1                  |          |           |            |          |           |
| Chinese.....       | 2      |          |           | 2       |                                  |          |           |                    |          |           |            |          |           |
| Dutch.....         | 60     | 22       | 15        | 97      | 45                               | 16       | 14        | 3                  |          | 1         | 11         | 4        |           |
| French.....        | 279    | 63       | 54        | 396     | 188                              | 38       | 36        | 20                 | 4        | 1         | 38         | 9        | 6         |
| German, N.E.S.     | 89     | 47       | 56        | 192     | 48                               | 22       | 34        | 8                  | 5        | 5         | 21         | 9        | 9         |
| Alsatian.....      | 1      |          |           | 1       |                                  |          |           |                    |          |           |            |          |           |
| Prussian.....      | 14     | 10       | 24        | 48      | 12                               | 8        | 24        | 1                  |          |           | 1          |          |           |
| English.....       | 3,404  | 1,425    | 1,344     | 6,173   | 1,975                            | 435      | 492       | 345                | 95       | 114       | 712        | 313      | 331       |
| Welsh.....         | 35     | 21       | 9         | 65      | 15                               | 6        | 5         | 2                  |          |           | 9          | 3        | 2         |
| Scotch.....        | 1,063  | 519      | 365       | 1,947   | 516                              | 83       | 106       | 89                 | 27       | 36        | 262        | 103      | 87        |
| Irish.....         | 211    | 96       | 49        | 356     | 127                              | 18       | 10        | 23                 | 7        | 12        | 30         | 17       | 14        |
| West Indian..      | 13     | 11       |           | 24      | 6                                |          |           | 3                  |          |           | 1          | 2        |           |
| Bermudian....      | 1      |          |           | 1       |                                  |          |           |                    |          |           |            |          |           |
| Jamaican.....      | 5      | 3        |           | 8       |                                  |          |           |                    |          |           | 3          |          |           |
| Greek.....         | 27     | 1        | 1         | 29      |                                  |          |           | 25                 |          | 1         | 1          |          |           |
| Hebrew, N.E.S.     | 4      | 8        | 8         | 20      |                                  | 1        | 1         |                    |          |           | 4          | 5        | 6         |
| " Russian          | 117    | 78       | 76        | 271     | 5                                | 4        | 4         | 19                 | 3        | 3         | 68         | 46       | 51        |
| " Polish..         | 1      |          |           | 1       |                                  |          |           |                    |          |           | 1          |          |           |
| " Austrian.        | 2      | 1        | 1         | 4       |                                  |          |           |                    |          |           | 1          |          |           |
| " German..         | 2      |          |           | 2       |                                  |          |           |                    |          |           | 2          |          |           |
| Italian.....       | 153    | 7        | 4         | 144     | 7                                |          |           | 114                | 4        | 3         | 7          | 1        |           |
| Japanese....       | 1      |          |           | 1       |                                  |          |           |                    |          |           |            |          |           |
| Newfoundland       | 7      | 6        | 2         | 15      |                                  |          |           | 5                  |          |           |            | 1        |           |
| New Zealand..      | 3      |          |           | 3       | 2                                |          |           |                    |          |           |            |          |           |
| Portuguese....     | 1      |          |           | 1       |                                  | 1        |           |                    |          |           |            |          |           |
| Polish, N.E.S.     | 16     | 1        |           | 17      |                                  |          |           | 5                  |          |           | 1          |          |           |
| " German..         | 2      |          |           | 2       |                                  |          |           |                    |          |           |            |          |           |
| " Russian..        | 21     | 3        | 4         | 28      | 1                                |          |           | 6                  |          |           |            |          |           |
| Romanian....       | 20     | 9        | 8         | 37      | 10                               | 3        | 5         | 5                  |          |           | 5          | 2        | 1         |
| Russian, N.E.S.    | 367    | 84       | 120       | 571     | 170                              | 51       | 81        | 158                | 9        | 19        | 35         | 10       | 17        |
| Finnish.....       | 119    | 19       | 2         | 140     | 29                               | 3        |           | 70                 | 5        | 2         | 15         | 1        |           |
| Spanish.....       | 3      | 1        |           | 4       |                                  |          |           |                    |          |           | 3          |          |           |
| Swiss.....         | 22     | 4        | 4         | 30      | 18                               | 4        | 4         |                    |          |           | 1          |          |           |
| Servian.....       | 5      | 5        | 20        | 30      |                                  |          |           |                    |          |           |            |          |           |
| Danish.....        | 18     | 5        |           | 23      | 10                               |          |           |                    |          |           | 6          | 1        |           |
| Icelandic....      | 2      | 1        | 1         | 4       | 2                                |          |           |                    |          |           |            | 1        | 1         |
| Swedish....        | 121    | 24       | 20        | 165     | 74                               | 11       | 16        | 33                 | 1        | 4         | 9          |          |           |
| Norwegian....      | 68     | 18       | 8         | 94      | 32                               | 5        | 1         | 29                 | 2        | 3         | 5          | 2        | 3         |
| Turkish.....       | 3      | 1        |           | 4       | 1                                |          |           | 2                  | 1        |           |            |          |           |
| Armenian....       | 33     | 18       | 8         | 59      | 6                                |          |           | 15                 | 4        | 5         | 9          | 3        | 2         |
| Syrian.....        | 59     | 16       | 15        | 90      | 18                               | 2        | 2         | 27                 | 3        | 4         | 5          | 3        | 4         |
| Arabian.....       |        | 1        |           | 1       |                                  |          |           |                    | 1        |           |            |          |           |
| U.S. A. citizens.  | 7      | 3        | 1         | 11      |                                  |          |           |                    |          |           | 5          | 1        |           |
| Negro.....         | 41     | 7        | 1         | 49      | 6                                | 1        | 1         | 10                 | 1        |           | 15         |          |           |
| Totals.....        | 7,839  | 2,916    | 2,624     | 13,379  | 4,386                            | 910      | 1,136     | 1,248              | 189      | 224       | 1,372      | 556      | 551       |



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## PORT OF ST. JOHN.

For the fiscal year 1908-9, there arrived at the port of St. John 21,213 passengers, of whom 1,024 travelled saloon and 20,189 steerage. Of the saloon passengers, 999 were destined to Canada and 25 to the United States. Of the steerage passengers 17,300 were for Canada and 2,889 for the United States. Included in the steerage passengers for Canada were 3,505 returned Canadians and 194 tourists, leaving the immigration proper at 13,601 souls, a decrease as compared with the preceding fiscal year of 4,293 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of St. John, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| Australian.....        | 1       | 2        |           | 3       |                |          |           |         | 1                         | 2        |           | 3       |
| Austrian.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Belgian.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Dutch.....             | 3       | 2        |           | 5       |                |          |           |         | 3                         | 2        |           | 5       |
| French.....            | 4       | 4        |           | 8       |                |          |           |         | 4                         | 4        |           | 8       |
| English.....           | 223     | 101      | 18        | 342     | 5              | 2        |           | 7       | 228                       | 103      | 18        | 349     |
| Welsh.....             | 5       | 3        |           | 8       |                |          |           |         | 5                         | 3        |           | 8       |
| Scotch.....            | 37      | 15       | 2         | 54      | 2              |          |           | 2       | 39                        | 15       | 2         | 56      |
| Irish.....             | 13      | 5        |           | 20      |                |          |           |         | 13                        | 5        |           | 20      |
| West Indian.....       | 31      | 46       | 19        | 96      | 3              |          |           | 3       | 34                        | 46       | 19        | 99      |
| Bermudian.....         | 1       | 5        | 1         | 7       |                |          |           |         | 1                         | 5        | 1         | 7       |
| Italian.....           | 1       | 1        |           | 2       | 1              | 1        |           | 2       | 2                         | 2        |           | 4       |
| New Zealand.....       | 1       | 1        |           | 2       |                |          |           |         | 1                         | 1        |           | 2       |
| Portuguese.....        |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Spanish.....           |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Swiss.....             | 1       | 1        | 1         | 3       |                |          |           |         | 1                         | 1        | 1         | 3       |
| Egyptian.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| U. S. A. citizens..... | 8       | 5        |           | 13      | 5              | 5        |           | 10      | 13                        | 10       |           | 23      |
| Negro.....             | 1       | 1        |           | 2       |                |          |           |         | 1                         | 1        |           | 2       |
| Canadian.....          | 192     | 131      | 17        | 340     |                |          |           |         | 192                       | 131      | 17        | 340     |
| Tourist.....           | 32      | 36       | 22        | 90      |                |          |           |         | 32                        | 36       | 22        | 90      |
| Totals.....            | 557     | 360      | 82        | 999     | 17             | 8        |           | 25      | 574                       | 368      | 82        | 1,024   |

TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of St. John, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....    | 1       | 2        | 2         | 5       |                |          |           |         | 1                         | 2        | 2         | 5       |
| Australian.....        | 3       | 4        |           | 7       |                |          |           |         | 3                         | 4        |           | 7       |
| Austrian, N.E.S.....   | 148     | 37       | 41        | 226     | 18             | 22       | 6         | 46      | 166                       | 59       | 47        | 272     |
| Bohemian.....          |         | 8        |           | 8       | 3              |          |           | 3       | 3                         | 8        |           | 11      |
| Bukowinian.....        | 903     | 40       | 26        | 969     | 1              | 1        |           | 2       | 964                       | 41       | 26        | 971     |
| Galician.....          | 2,415   | 353      | 256       | 3,024   | 13             | 14       | 5         | 32      | 2,428                     | 367      | 261       | 3,056   |
| Hungarian.....         | 35      | 16       | 23        | 74      | 21             | 21       | 13        | 55      | 56                        | 37       | 36        | 129     |
| Belgian.....           | 91      | 33       | 42        | 166     | 9              | 6        | 8         | 23      | 100                       | 39       | 50        | 189     |
| Bulgarian.....         |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Chinese.....           | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Dutch.....             | 26      | 13       | 28        | 67      | 2              | 1        | 1         | 4       | 28                        | 14       | 29        | 71      |
| French.....            | 19      | 11       | 8         | 38      |                |          |           |         | 19                        | 11       | 8         | 38      |
| German, N.E.S.....     | 81      | 47       | 60        | 188     | 44             | 22       | 24        | 90      | 125                       | 69       | 84        | 278     |
| Prussian.....          | 5       | 4        | 13        | 22      |                | 1        | 1         | 2       | 5                         | 5        | 14        | 24      |
| English.....           | 2,906   | 1,405    | 981       | 5,292   | 131            | 82       | 68        | 281     | 3,037                     | 1,487    | 1,049     | 5,573   |
| Welsh.....             | 57      | 17       | 16        | 90      | 3              | 1        |           | 4       | 60                        | 18       | 16        | 94      |
| Scotch.....            | 638     | 268      | 180       | 1,086   | 53             | 16       | 10        | 79      | 691                       | 284      | 190       | 1,165   |
| Irish.....             | 343     | 132      | 83        | 558     | 36             | 8        | 1         | 45      | 379                       | 140      | 84        | 603     |
| West Indian.....       | 28      | 27       | 4         | 59      | 3              | 4        |           | 7       | 31                        | 31       | 4         | 66      |
| Bermudian.....         | 3       | 3        | 1         | 7       |                |          |           |         | 3                         | 3        | 1         | 7       |
| Jamaican.....          |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Greek.....             | 15      |          | 2         | 17      |                |          |           |         | 15                        |          | 2         | 17      |
| Hebrew, N.E.S.....     | 9       | 3        | 3         | 15      | 4              | 1        | 2         | 7       | 13                        | 4        | 5         | 22      |
| " Russian.....         | 63      | 57       | 57        | 177     | 2              | 2        | 1         | 5       | 65                        | 59       | 58        | 182     |
| " Austrian.....        | 1       | 1        |           | 2       |                |          |           |         | 1                         | 1        |           | 2       |
| " German.....          | 1       | 1        |           | 2       |                |          |           |         | 1                         | 1        |           | 2       |
| Italian.....           | 185     | 4        | 2         | 191     | 3              | 1        | 1         | 5       | 188                       | 5        | 3         | 196     |
| Japanese.....          |         |          |           |         | 5              | 1        |           | 6       | 5                         | 1        |           | 6       |
| Newfoundland.....      | 4       |          |           | 4       |                |          |           |         | 4                         |          |           | 4       |
| Polish, N.E.S.....     | 10      | 3        |           | 13      | 5              | 6        |           | 11      | 15                        | 9        |           | 24      |
| " Russian.....         | 23      | 13       | 14        | 50      |                | 6        | 6         | 12      | 23                        | 19       | 20        | 62      |
| Roumanian.....         | 26      | 18       | 27        | 71      | 1              | 1        |           | 2       | 27                        | 19       | 27        | 73      |
| Russian, N.E.S.....    | 361     | 110      | 88        | 559     | 127            | 100      | 104       | 331     | 488                       | 210      | 192       | 890     |
| Finnish.....           | 178     | 41       | 21        | 240     | 730            | 114      | 53        | 897     | 908                       | 155      | 74        | 1,137   |
| Swiss.....             | 4       |          |           | 4       | 2              | 2        | 1         | 5       | 6                         | 2        | 4         | 12      |
| Servian.....           |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Danish.....            | 27      | 7        | 2         | 36      | 60             | 15       | 13        | 88      | 87                        | 22       | 15        | 124     |
| Icelandic.....         | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Swedish.....           | 123     | 29       | 11        | 163     | 148            | 27       | 8         | 183     | 271                       | 56       | 19        | 346     |
| Norwegian.....         | 107     | 18       | 11        | 136     | 317            | 105      | 60        | 482     | 424                       | 123      | 71        | 618     |
| Turkish.....           |         |          |           |         | 1              | 1        |           | 2       | 1                         | 1        |           | 2       |
| Egyptian.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Syrian.....            | 2       | 1        |           | 3       |                |          |           |         | 2                         | 1        |           | 3       |
| U. S. A. citizens..... | 3       | 1        |           | 4       | 100            | 38       | 21        | 159     | 103                       | 39       | 21        | 163     |
| Negro.....             | 8       | 15       | 1         | 24      |                |          |           |         | 8                         | 15       | 1         | 24      |
| Total immigration..... | 8,855   | 2,743    | 2,093     | 13,691  | 1,844          | 619      | 410       | 2,873   | 10,699                    | 3,362    | 2,413     | 16,474  |
| Returned Canadians ..  | 2,665   | 535      | 305       | 3,505   |                |          |           |         | 2,665                     | 535      | 305       | 3,505   |
| Tourists.....          | 123     | 48       | 23        | 194     | 13             | 3        |           | 16      | 136                       | 51       | 23        | 210     |
| Totals ..              | 11,643  | 3,326    | 2,331     | 17,300  | 1,857          | 622      | 410       | 2,889   | 13,500                    | 3,948    | 2,741     | 20,189  |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of St. John, for the fiscal Year ending March 31, 1909.

| —                     | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar.  | Totals |
|-----------------------|--------|------|-------|-------|------|-------|------|------|------|------|------|-------|--------|
| African, South....    | 1      |      |       |       |      |       |      |      |      | 4    |      |       | 5      |
| Australian....        | 2      |      |       |       |      |       |      |      | 1    | 2    |      | 2     | 7      |
| Austrian, N. E. S.    | 133    |      |       |       |      |       |      | 20   | 2    | 14   | 28   | 29    | 226    |
| Bohemian.....         | 6      |      |       |       |      |       |      |      |      |      |      | 2     | 8      |
| Bukowinian.....       | 941    |      |       |       |      |       |      | 3    |      | 1    |      | 24    | 969    |
| Galician.....         | 2,793  |      |       |       |      |       |      | 21   | 15   | 61   | 18   | 116   | 3,024  |
| Hungarian.....        | 28     |      |       |       |      |       |      |      | 13   | 18   |      | 15    | 74     |
| Belgian.....          | 67     |      |       |       |      |       |      | 3    | 9    | 34   | 10   | 43    | 166    |
| Chinese.....          | 1      |      |       |       |      |       |      |      |      |      |      |       | 1      |
| Dutch.....            | 13     |      |       |       |      |       |      | 2    | 2    |      | 1    | 49    | 67     |
| French.....           | 19     |      |       |       |      |       |      | 4    | 1    | 3    |      | 11    | 38     |
| German, N. E. S.      | 99     |      |       |       |      |       |      | 5    | 7    | 20   | 25   | 32    | 188    |
| Prussian.....         | 22     |      |       |       |      |       |      |      |      |      |      |       | 22     |
| English.....          | 2,708  |      |       | 1     |      | 1     |      | 121  | 343  | 309  | 364  | 1,445 | 5,292  |
| Welsh.....            | 40     |      |       |       |      |       |      | 7    | 8    | 2    | 3    | 25    | 90     |
| Scotch.....           | 461    |      |       |       | 1    |       |      | 18   | 81   | 61   | 78   | 386   | 1,086  |
| Irish.....            | 293    |      |       |       |      |       |      | 7    | 43   | 12   | 28   | 175   | 558    |
| West Indian.....      | 6      | 11   |       | 6     | 8    | 17    | 3    | 1    | 2    |      |      | 3     | 59     |
| Bernudian.....        | 3      |      |       |       | 1    |       | 2    | 1    |      |      |      |       | 7      |
| Jamaican.....         |        |      |       |       |      |       | 1    |      |      |      |      |       | 1      |
| Greek.....            | 4      |      |       |       |      |       |      |      |      |      |      | 13    | 17     |
| Hebrew, N. E. S.      | 5      |      |       |       |      |       |      |      |      | 6    | 4    |       | 15     |
| "    Russian.....     | 63     |      |       |       |      |       |      | 24   | 21   | 40   | 17   | 12    | 177    |
| "    Austrian.....    | 2      |      |       |       |      |       |      |      |      |      |      |       | 2      |
| "    German.....      |        |      |       |       |      |       |      |      |      | 2    |      |       | 2      |
| Italian.....          | 169    |      |       |       |      |       |      |      | 1    | 3    | 2    | 16    | 191    |
| Newfoundland....      | 4      |      |       |       |      |       |      |      |      |      |      |       | 4      |
| Polish, N. E. S.      | 2      |      |       |       |      |       |      |      |      |      | 11   |       | 13     |
| "    Russian.....     | 25     |      |       |       |      |       |      | 5    |      | 16   |      | 4     | 50     |
| Roumanian.....        | 32     |      |       |       |      |       |      | 8    | 4    | 3    | 5    | 19    | 71     |
| Russian, N. E. S.     | 218    |      |       |       |      |       |      | 17   | 39   | 104  | 97   | 84    | 559    |
| Finnish.....          | 14     |      |       |       |      |       |      | 19   | 64   | 75   | 36   | 32    | 240    |
| Swiss.....            | 2      |      |       |       |      |       |      | 1    |      | 1    |      |       | 4      |
| Danish.....           | 18     |      |       |       |      |       |      | 1    | 4    | 2    |      | 11    | 36     |
| Icelandic.....        |        |      |       |       |      |       |      |      |      |      | 1    |       | 1      |
| Swedish.....          | 43     |      |       |       |      |       |      | 5    | 22   | 13   | 25   | 55    | 163    |
| Norwegian.....        | 37     |      |       |       |      |       |      | 2    | 9    | 5    | 8    | 75    | 136    |
| Egyptian.....         |        |      |       |       |      |       |      |      | 1    |      |      |       | 1      |
| Syrian.....           |        |      |       |       |      | 2     |      |      | 1    |      |      |       | 3      |
| U. S. A. citizens.... | 2      |      |       |       |      |       | 10   |      | 1    | 1    |      |       | 4      |
| Negro.....            |        | 2    | 9     |       | 2    | 1     |      |      |      |      |      |       | 24     |
| Totals.....           | 8,281  | 13   | 9     | 7     | 12   | 21    | 16   | 295  | 694  | 814  | 761  | 2,678 | 13,601 |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada by Occupation and Destination, at the Port of St. John, for the fiscal Year ending March 31, 1909.

| —                           | April.       | May.      | June.    | July     | Aug.      | Sept.     | Oct.      | Nov.       | Dec.       | Jan.       | Feb.       | Mar.         | Totals        |
|-----------------------------|--------------|-----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|--------------|---------------|
| Agriculturists. . . . .     | 1,671        | 1         |          |          |           | 1         |           | 24         | 111        | 67         | 111        | 850          | 2,836         |
| General labourers . . . . . | 3,983        | 3         | 1        |          | 3         | 2         |           | 70         | 169        | 282        | 249        | 777          | 5,539         |
| Mechanics . . . . .         | 1,249        | 2         |          | 3        |           | 1         |           | 53         | 121        | 171        | 156        | 455          | 2,211         |
| Clerks . . . . .            | 367          | 4         | 4        | 1        | 2         | 8         | 1         | 20         | 80         | 51         | 73         | 224          | 835           |
| Miners . . . . .            | 93           |           |          |          |           |           |           | 26         | 30         | 45         | 41         | 61           | 296           |
| Female servants . . . . .   | 421          | 3         | 4        | 1        | 6         | 9         | 11        | 34         | 58         | 58         | 53         | 158          | 816           |
| Not classed. . . . .        | 497          |           |          | 2        | 1         |           | 4         | 68         | 125        | 140        | 78         | 153          | 1,068         |
| <b>Totals . . . . .</b>     | <b>8,281</b> | <b>13</b> | <b>9</b> | <b>7</b> | <b>12</b> | <b>21</b> | <b>16</b> | <b>295</b> | <b>694</b> | <b>814</b> | <b>761</b> | <b>2,678</b> | <b>13,601</b> |
| Maritime Provinces          | 469          | 4         | 2        | 6        | 6         | 11        | 8         | 30         | 59         | 93         | 37         | 217          | 942           |
| Quebec . . . . .            | 1,328        | 6         | 2        |          | 2         | 2         |           | 64         | 98         | 131        | 111        | 179          | 1,923         |
| Ontario . . . . .           | 1,935        | 1         | 5        | 1        | 3         | 8         | 8         | 74         | 237        | 237        | 229        | 705          | 3,443         |
| Manitoba . . . . .          | 2,751        |           |          |          | 1         |           |           | 34         | 80         | 127        | 124        | 659          | 3,776         |
| Saskatchewan . . . . .      | 732          |           |          |          |           |           |           | 19         | 48         | 54         | 54         | 298          | 1,205         |
| Alberta . . . . .           | 690          |           |          |          |           |           |           | 32         | 56         | 74         | 84         | 350          | 1,286         |
| British Columbia . . . . .  | 376          | 2         |          |          |           |           |           | 42         | 116        | 98         | 121        | 270          | 1,025         |
| Yukon. . . . .              |              |           |          |          |           |           |           |            |            |            | 1          |              | 1             |
| <b>Totals . . . . .</b>     | <b>8,281</b> | <b>13</b> | <b>9</b> | <b>7</b> | <b>12</b> | <b>21</b> | <b>16</b> | <b>295</b> | <b>694</b> | <b>814</b> | <b>761</b> | <b>2,678</b> | <b>13,601</b> |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant Arrivals for

|                        | SEX.   |          |           |         | TRADE OR                               |          |           |                       |          |           |            |          |           |  |
|------------------------|--------|----------|-----------|---------|--|----------|-----------|-----------------------|----------|-----------|------------|----------|-----------|--|
|                        |        |          |           |         | Farmers or<br>Farm Labourers<br>Class. |          |           | General<br>Labourers. |          |           | Mechanics. |          |           |  |
|                        | Males. | Females. | Children. | Totals. | Males.                                 | Females. | Children. | Males.                | Females. | Children. | Males.     | Females. | Children. |  |
| African, South.....    | 1      | 2        | 2         | 5       | 1                                      | 1        | 2         |                       |          |           |            |          | 1         |  |
| Australian.....        | 3      | 4        |           | 7       | 2                                      |          |           |                       |          |           |            |          | 1         |  |
| Austrian, N.E.S.....   | 148    | 37       | 41        | 226     | 6                                      | 3        | 5         | 131                   | 17       | 31        | 8          | 5        | 5         |  |
| Bohemian.....          |        | 5        |           | 8       |  |          |           |                       |          |           |            |          |           |  |
| Bukowinian.....        | 903    | 40       | 26        | 969     | 73                                     | 2        |           | 822                   | 15       | 21        | 5          |          |           |  |
| Galician.....          | 2,415  | 353      | 256       | 3,024   | 287                                    | 28       | 48        | 2,098                 | 115      | 153       | 18         | 5        | 3         |  |
| Hungarian.....         | 35     | 16       | 23        | 74      | 6                                      | 2        | 5         | 25                    | 4        | 6         | 1          | 3        | 4         |  |
| Belgian.....           | 91     | 33       | 42        | 166     | 23                                     | 13       | 20        | 33                    | 5        | 7         | 9          | 3        |           |  |
| Chinese.....           | 1      |          |           | 1       |  |          |           | 1                     |          |           |            |          |           |  |
| Dutch.....             | 26     | 13       | 28        | 67      | 20                                     | 4        | 18        | 2                     |          |           |            |          |           |  |
| French.....            | 19     | 11       | 8         | 38      | 4                                      | 1        |           | 2                     |          |           |            | 3        |           |  |
| German, N.E.S.....     | 81     | 47       | 60        | 188     | 15                                     | 9        | 14        | 46                    | 14       | 31        | 8          | 5        | 7         |  |
| Prussian.....          | 5      | 4        | 13        | 22      |  |          |           | 2                     | 1        | 3         |            |          |           |  |
| English.....           | 2,906  | 1,405    | 981       | 5,292   | 1,094                                  | 275      | 190       | 442                   | 134      | 110       | 834        | 324      | 326       |  |
| Welsh.....             | 57     | 17       | 16        | 90      | 19                                     | 2        | 1         | 5                     |          |           | 21         | 2        | 7         |  |
| Scotch.....            | 638    | 268      | 180       | 1,086   | 234                                    | 47       | 68        | 75                    | 9        | 2         | 209        | 64       | 57        |  |
| Irish.....             | 343    | 132      | 83        | 558     | 138                                    | 15       | 27        | 56                    | 8        | 10        | 67         | 12       | 17        |  |
| West Indian.....       | 28     | 27       | 4         | 59      | 2                                      |          |           | 8                     |          |           | 5          | 1        |           |  |
| Bernudian.....         | 3      | 3        | 1         | 7       |  |          |           | 1                     |          |           | 1          |          |           |  |
| Jamaican.....          |        | 1        |           | 1       |  |          |           |                       |          |           |            |          |           |  |
| Greek.....             | 15     |          | 2         | 17      |  |          |           | 14                    |          | 2         | 1          |          |           |  |
| Hebrew, N.E.S.....     | 9      | 3        | 3         | 15      | 1                                      |          |           | 5                     |          | 1         | 2          | 1        |           |  |
| "    Russian.....      | 63     | 57       | 57        | 177     | 2                                      |          |           | 30                    | 9        | 13        | 30         | 28       | 20        |  |
| "    Austrian.....     | 1      | 1        |           | 2       |  |          |           |                       |          |           | 1          | 1        |           |  |
| "    German.....       | 1      | 1        |           | 2       |  |          |           |                       |          |           | 1          | 1        |           |  |
| Italian.....           | 185    | 4        | 2         | 191     |  |          |           | 180                   | 3        | 1         | 1          |          |           |  |
| Newfoundland.....      | 4      |          |           | 4       |  |          |           | 4                     |          |           |            |          |           |  |
| Polish, N.E.S.....     | 10     | 3        |           | 13      |  |          |           | 10                    |          |           |            |          |           |  |
| "    Russian.....      | 23     | 13       | 14        | 50      | 3                                      |          |           | 17                    | 5        | 8         | 3          | 1        | 3         |  |
| Roumanian.....         | 26     | 18       | 27        | 71      | 1                                      |          |           | 20                    | 8        | 17        | 4          | 3        | 5         |  |
| Russian, N.E.S.....    | 361    | 110      | 88        | 559     | 22                                     | 4        | 3         | 297                   | 28       | 40        | 19         | 12       | 3         |  |
| Finnish.....           | 178    | 41       | 21        | 240     | 17                                     | 2        |           | 154                   | 9        | 3         | 3          |          |           |  |
| Swiss.....             | 4      |          |           | 4       | 2                                      |          |           |                       |          |           | 2          |          |           |  |
| Danish.....            | 27     | 7        | 2         | 36      | 12                                     | 1        |           | 10                    |          |           | 4          | 2        | 2         |  |
| Icelandic.....         | 1      |          |           | 1       |  |          |           |                       |          |           |            |          |           |  |
| Swedish.....           | 123    | 29       | 11        | 163     | 12                                     | 2        | 2         | 100                   | 7        | 3         | 9          |          |           |  |
| Norwegian.....         | 107    | 18       | 11        | 136     | 20                                     | 1        | 3         | 82                    | 4        | 4         | 3          | 1        | 1         |  |
| Egyptian.....          | 1      |          |           | 1       |  |          |           |                       |          |           |            |          |           |  |
| Syrian.....            | 2      | 1        |           | 3       |  |          |           |                       |          |           |            |          |           |  |
| U. S. A. citizens..... | 3      | 1        |           | 4       |  |          |           | 2                     | 1        |           | 1          |          |           |  |
| Negro.....             | 8      | 15       | 1         | 24      | 1                                      |          |           | 3                     |          |           |            | 1        |           |  |
| Totals.....            | 8,855  | 2,743    | 2,003     | 13,601  | 2,018                                  | 412      | 406       | 4,677                 | 396      | 466       | 1,275      | 476      | 460       |  |



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V.

Canada at the Port of St. John, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.             |          |           |         |          |           |                  |                 |          | DESTINATION. |                        |         |          |           |               |          |                   |        |
|-------------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|--------------|------------------------|---------|----------|-----------|---------------|----------|-------------------|--------|
| Clerks,<br>Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |              | Maritime<br>Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. | Yukon. |
| Males.                  | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children.    |                        |         |          |           |               |          |                   |        |
|                         |          |           |         |          |           | 1                |                 |          | 1            |                        |         |          |           | 3             |          |                   |        |
|                         | 1        |           |         |          |           | 10               | 1               | 12       | 1            | 3                      |         |          |           | 33            |          | 3                 |        |
|                         |          |           | 2       |          |           | 8                |                 |          | 23           | 57                     | 17      | 54       | 22        | 33            |          | 20                |        |
|                         |          |           |         |          |           | 20               |                 | 3        | 6            |                        |         |          |           |               |          | 12                |        |
| 1                       |          |           | 10      |          |           | 162              | 1               | 43       | 106          | 279                    | 112     | 376      | 56        | 32            |          | 8                 |        |
|                         |          |           |         |          |           | 3                | 1               | 4        | 91           | 457                    | 428     | 1,673    | 169       | 182           |          | 24                |        |
| 3                       | 1        |           | 23      | 6        | 7         | 3                |                 | 3        | 11           | 7                      | 8       | 11       | 29        |               | 2        |                   |        |
|                         |          |           |         |          |           | 3                |                 | 3        | 34           | 23                     | 2       | 43       | 4         | 50            |          | 10                |        |
| 3                       | 5        | 9         |         |          |           | 2                | 1               | 2        | 1            | 1                      | 3       | 1        | 7         | 37            |          | 1                 |        |
| 4                       | 12       |           | 5       | 4        | 8         |                  | 1               | 4        | 3            | 3                      | 1       | 12       | 1         | 12            |          | 6                 |        |
| 8                       | 3        | 1         | 3       | 1        | 3         | 10               | 1               | 5        | 19           | 21                     | 10      | 28       | 56        | 41            |          | 13                |        |
|                         |          |           | 1       |          |           | 1                | 1               | 3        | 1            |                        |         |          |           | 21            |          |                   |        |
| 388                     | 101      | 62        | 59      | 25       | 36        | 302              | 89              | 244      | 365          | 420                    | 1,874   | 885      | 597       | 535           |          | 616               |        |
| 6                       | 1        | 1         | 5       | 3        | 4         | 4                | 1               | 5        | 5            | 10                     | 21      | 24       | 8         | 9             |          | 13                |        |
| 64                      | 17       | 7         | 39      | 3        | 4         | 81               | 17              | 47       | 69           | 74                     | 292     | 241      | 114       | 153           |          | 142               |        |
| 68                      | 24       | 12        | 4       | 3        | 3         | 55               | 10              | 15       | 9            | 53                     | 184     | 153      | 30        | 86            |          | 43                |        |
| 13                      | 1        | 1         |         |          |           | 24               |                 | 1        | 27           | 9                      | 21      | 1        |           |               |          | 1                 |        |
| 1                       |          |           |         |          |           | 2                |                 | 1        | 6            |                        | 1       |          |           |               |          |                   |        |
|                         |          |           |         |          |           | 1                |                 |          |              |                        |         |          |           |               |          |                   |        |
| 1                       |          |           |         |          |           |                  |                 | 2        |              | 13                     | 17      |          |           |               |          |                   |        |
|                         | 3        | 4         |         |          |           | 6                | 1               | 11       | 8            | 97                     | 37      | 29       | 6         |               |          |                   |        |
|                         |          |           |         |          |           |                  |                 |          |              | 2                      |         |          |           |               |          |                   |        |
|                         |          |           | 4       |          |           |                  |                 | 1        |              | 1                      |         |          |           |               |          |                   |        |
|                         |          |           |         |          |           |                  |                 | 1        | 24           | 129                    | 37      |          |           | 1             |          |                   |        |
|                         |          |           |         |          |           |                  |                 |          | 4            |                        |         |          |           |               |          |                   |        |
|                         |          |           |         |          |           | 2                |                 |          |              | 2                      | 9       | 2        |           |               |          |                   |        |
|                         |          |           |         |          |           | 3                |                 | 4        | 2            | 23                     | 4       | 17       |           | 4             |          |                   |        |
|                         |          |           |         |          |           | 3                | 1               | 4        | 28           | 5                      | 18      |          | 17        | 3             |          |                   |        |
| 1                       | 1        | 5         | 20      |          |           | 47               | 2               | 18       | 90           | 146                    | 101     | 120      | 46        | 20            |          | 36                |        |
|                         |          |           | 4       |          |           | 27               |                 | 3        | 4            | 29                     | 166     | 6        | 5         | 10            |          | 29                |        |
|                         |          |           |         |          |           |                  |                 |          |              | 2                      | 2       |          |           |               |          |                   |        |
| 1                       |          |           |         |          |           | 4                |                 |          | 7            | 5                      | 2       | 13       | 1         | 6             |          | 2                 |        |
|                         |          |           |         |          |           |                  |                 |          |              | 1                      |         |          |           |               |          |                   |        |
|                         |          |           | 1       |          |           | 17               | 1               | 3        | 6            | 6                      | 15      | 55       | 42        | 3             | 22       | 20                |        |
| 2                       | 1        |           |         |          |           | 6                |                 | 5        | 3            | 10                     | 6       | 14       | 27        | 34            | 26       | 19                |        |
| 1                       |          |           |         |          |           |                  |                 |          |              |                        |         | 1        |           |               |          |                   |        |
| 2                       | 1        |           |         |          |           |                  |                 |          |              | 2                      |         | 1        |           |               |          |                   |        |
|                         |          |           |         |          |           |                  |                 |          | 3            |                        |         |          |           |               |          |                   |        |
| 4                       |          |           |         |          |           | 14               |                 |          | 1            | 10                     | 3       |          |           |               |          | 1                 |        |
| 571                     | 162      | 102       | 185     | 46       | 65        | 816              | 129             | 435      | 942          | 1,923                  | 3,443   | 3,776    | 1,205     | 1,286         | 1,025    | 1                 |        |

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## PORT OF QUEBEC.

For the fiscal year 1908-9, there arrived at the port of Quebec 71,218 passengers, of whom 6,698 travelled saloon and 64,520 steerage. Of the saloon passengers, 5,539 were destined to Canada and 1,159 to the United States. Of the steerage passengers, 56,198 were for Canada and 8,322 for the United States. Included in the steerage passengers for Canada were 10,113 returned Canadians and 2,015 tourists, leaving the immigration proper at 44,070 souls, a decrease as compared with the preceding fiscal year of 68,254 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of Quebec, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....    | 1       |          |           | 1       | 2              |          |           | 2       | 3                         |          |           | 3       |
| Australian.....        | 9       | 6        |           | 15      | 1              |          |           | 1       | 10                        | 6        |           | 16      |
| Austrian.....          | 6       |          |           | 6       |                | 1        |           | 1       | 6                         | 1        |           | 7       |
| Belgian.....           | 4       | 3        |           | 7       | 1              |          |           | 1       | 5                         | 3        |           | 8       |
| Chinese.....           | 12      |          |           | 2       | 1              |          |           | 1       | 3                         |          |           | 3       |
| Dutch.....             | 2       | 1        |           | 3       | 1              |          |           | 1       | 3                         | 1        |           | 4       |
| French.....            | 30      | 22       | 2         | 54      | 2              | 2        |           | 4       | 32                        | 24       | 2         | 58      |
| German.....            | 9       | 7        |           | 16      | 3              | 3        |           | 6       | 12                        | 10       |           | 22      |
| English.....           | 1,196   | 765      | 101       | 2,062   | 66             | 35       | 5         | 106     | 1,262                     | 800      | 106       | 2,168   |
| Welsh.....             | 24      | 8        |           | 32      |                |          |           |         | 24                        | 8        |           | 32      |
| Scotch.....            | 325     | 229      | 31        | 585     | 42             | 30       |           | 72      | 367                       | 259      | 31        | 657     |
| Irish.....             | 37      | 45       | 4         | 116     | 3              | 5        |           | 8       | 70                        | 50       | 4         | 124     |
| Jamaican.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Italian.....           | 6       |          |           | 6       |                |          |           |         | 6                         |          |           | 6       |
| Newfoundland.....      |         |          |           |         |                | 1        |           | 1       |                           | 1        |           | 1       |
| New Zealand.....       | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| Spanish.....           | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Swiss.....             | 4       |          |           | 4       |                |          |           |         | 4                         |          |           | 4       |
| Danish.....            | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Swedish.....           | 4       | 3        |           | 7       | 1              |          |           | 1       | 5                         | 3        |           | 8       |
| Norwegian.....         |         | 3        |           | 3       |                |          |           |         |                           | 3        |           | 3       |
| Armenian.....          |         |          |           |         | 1              | 1        |           | 2       | 1                         | 1        |           | 2       |
| Syrian.....            |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| U. S. A. citizens..... | 29      | 30       | 7         | 66      | 354            | 544      | 40        | 938     | 383                       | 574      | 47        | 1,004   |
| Canadian.....          | 1,033   | 1,009    | 192       | 2,234   | 6              | 2        |           | 8       | 1,039                     | 1,011    | 192       | 2,242   |
| Tourist.....           | 161     | 135      | 18        | 314     | 1              | 4        |           | 5       | 162                       | 139      | 18        | 319     |
| Totals.....            | 2,918   | 2,266    | 355       | 5,539   | 486            | 628      | 45        | 1,159   | 3,404                     | 2,894    | 400       | 6,698   |

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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of Quebec, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....    | 12      | 9        | 9         | 30      | 1              | .....    | .....     | 1       | 13                        | 9        | 9         | 31      |
| Australian.....        | 25      | 11       | 8         | 44      | 1              | 1        | 4         | 6       | 26                        | 12       | 12        | 50      |
| Austrian, N.E.S.....   | 143     | 57       | 58        | 258     | 31             | 42       | 24        | 97      | 174                       | 99       | 82        | 355     |
| Bohemian.....          | 3       | 5        | 7         | 15      | 4              | 1        | .....     | 5       | 7                         | 6        | 18        |         |
| Bukowinian.....        | 191     | 36       | 34        | 261     | 2              | .....    | .....     | 2       | 193                       | 36       | 34        | 263     |
| Croatian.....          | 1       | .....    | .....     | 1       | 5              | .....    | .....     | 5       | 6                         | .....    | .....     | 6       |
| Galician.....          | 1,220   | 375      | 478       | 2,073   | 7              | 14       | 12        | 33      | 1,227                     | 389      | 490       | 2,106   |
| Hungarian, N.E.S.....  | 27      | 15       | 18        | 60      | 16             | 23       | 21        | 60      | 43                        | 38       | 39        | 120     |
| Belgian.....           | 164     | 93       | 86        | 343     | 19             | 9        | 11        | 39      | 183                       | 102      | 97        | 382     |
| Bulgarian.....         | 20      | 2        | .....     | 22      | 2              | 5        | 2         | 9       | 22                        | 7        | 2         | 31      |
| Chinese.....           | 20      | .....    | .....     | 20      | .....          | .....    | .....     | .....   | 20                        | .....    | .....     | 20      |
| Dutch.....             | 97      | 69       | 63        | 229     | 21             | 13       | 17        | 51      | 118                       | 82       | 80        | 280     |
| French.....            | 617     | 296      | 131       | 1,044   | 29             | 27       | 14        | 70      | 646                       | 323      | 145       | 1,114   |
| German, N.E.S.....     | 246     | 128      | 121       | 495     | 100            | 100      | 82        | 282     | 346                       | 228      | 203       | 777     |
| Prussian.....          | 2       | 1        | .....     | 3       | .....          | .....    | .....     | .....   | 2                         | 1        | .....     | 3       |
| Saxon.....             | 1       | .....    | 7         | 8       | .....          | .....    | .....     | .....   | .....                     | .....    | 7         | 8       |
| English.....           | 9,163   | 7,969    | 6,329     | 23,461  | 556            | 495      | 279       | 1,370   | 9,759                     | 8,464    | 6,608     | 24,831  |
| Welsh.....             | 116     | 89       | 72        | 277     | 25             | 19       | 11        | 55      | 141                       | 108      | 83        | 332     |
| Scotch.....            | 3,412   | 3,024    | 1,928     | 8,364   | 205            | 175      | 94        | 474     | 3,617                     | 3,199    | 2,022     | 8,838   |
| Irish.....             | 1,037   | 928      | 443       | 2,408   | 99             | 79       | 25        | 203     | 1,136                     | 1,007    | 468       | 2,611   |
| West Indian.....       | 2       | .....    | .....     | 2       | .....          | .....    | .....     | .....   | 2                         | .....    | .....     | 2       |
| Bermudian.....         | .....   | 1        | 1         | 2       | .....          | .....    | .....     | .....   | .....                     | 1        | 1         | 2       |
| Greek.....             | 29      | 4        | 5         | 38      | 9              | .....    | .....     | 9       | 38                        | 4        | 5         | 47      |
| Hebrew, N.E.S.....     | 37      | 26       | 27        | 90      | 13             | 10       | 17        | 40      | 50                        | 36       | 44        | 130     |
| " Russian.....         | 248     | 318      | 329       | 895     | 10             | 14       | 27        | 51      | 258                       | 332      | 356       | 946     |
| " Polish.....          | 1       | .....    | .....     | 1       | .....          | .....    | .....     | .....   | 1                         | .....    | .....     | 1       |
| " Austrian.....        | 4       | 3        | 6         | 13      | .....          | .....    | .....     | .....   | 4                         | 3        | 6         | 13      |
| " German.....          | 3       | 4        | 4         | 11      | .....          | .....    | .....     | .....   | 3                         | 4        | 4         | 11      |
| Italian.....           | 201     | 24       | 10        | 235     | 9              | 1        | .....     | 10      | 210                       | 25       | 10        | 245     |
| Japanese.....          | 2       | .....    | .....     | 2       | .....          | .....    | .....     | .....   | 2                         | .....    | .....     | 2       |
| Newfoundland.....      | 2       | .....    | .....     | 2       | .....          | .....    | .....     | .....   | 2                         | .....    | .....     | 2       |
| New Zealand.....       | 7       | 4        | 1         | 12      | .....          | 1        | .....     | 1       | 7                         | 5        | 1         | 13      |
| Portuguese.....        | .....   | .....    | .....     | .....   | 1              | .....    | .....     | .....   | 1                         | .....    | .....     | 1       |
| Polish, N.E.S.....     | 22      | 10       | 9         | 41      | 5              | 7        | 7         | 19      | 27                        | 17       | 16        | 60      |
| " Austrian.....        | 8       | 1        | 1         | 10      | .....          | .....    | .....     | .....   | 8                         | 1        | 1         | 10      |
| " German.....          | 1       | .....    | .....     | 1       | .....          | .....    | .....     | .....   | 1                         | .....    | .....     | 1       |
| " Russian.....         | 81      | 42       | 40        | 163     | 2              | 4        | 3         | 9       | 83                        | 46       | 43        | 172     |
| Persian.....           | 1       | .....    | .....     | 1       | .....          | .....    | .....     | .....   | 1                         | .....    | .....     | 1       |
| Roumanian.....         | 25      | 36       | 33        | 94      | 7              | 10       | 9         | 26      | 32                        | 46       | 42        | 120     |
| Russian, N.E.S.....    | 503     | 371      | 561       | 1,435   | 228            | 265      | 314       | 807     | 731                       | 636      | 875       | 2,242   |
| Finnish.....           | 102     | 93       | 56        | 251     | 212            | 176      | 129       | 517     | 314                       | 269      | 185       | 768     |
| Spanish.....           | 12      | 1        | .....     | 13      | .....          | .....    | .....     | .....   | 12                        | 1        | .....     | 13      |
| Swiss.....             | 45      | 15       | 10        | 70      | 10             | 13       | 6         | 29      | 55                        | 28       | 16        | 99      |
| Servian.....           | 1       | .....    | .....     | 1       | 2              | .....    | .....     | 2       | 3                         | .....    | .....     | 3       |
| Danish.....            | 34      | 18       | 4         | 56      | 96             | 48       | 36        | 150     | 100                       | 66       | 40        | 206     |
| Icelandic.....         | 14      | 12       | 4         | 30      | .....          | 1        | .....     | 1       | 14                        | 13       | 4         | 31      |
| Swedish.....           | 303     | 198      | 162       | 663     | 292            | 219      | 113       | 624     | 595                       | 417      | 275       | 1,287   |
| Norwegian.....         | 176     | 121      | 99        | 396     | 516            | 413      | 185       | 1,114   | 692                       | 534      | 284       | 1,510   |
| Turkish.....           | 2       | .....    | .....     | 2       | 10             | 3        | .....     | 18      | 12                        | 3        | 5         | 20      |
| Armenian.....          | 4       | 5        | 4         | 13      | .....          | .....    | .....     | .....   | 4                         | 5        | 4         | 13      |
| Egyptian.....          | .....   | .....    | .....     | .....   | 2              | .....    | .....     | 2       | 2                         | .....    | .....     | 2       |
| Syrian.....            | 33      | 12       | 6         | 51      | .....          | .....    | .....     | .....   | 33                        | 12       | 6         | 51      |
| Arabian.....           | 2       | .....    | .....     | 2       | .....          | .....    | .....     | .....   | 2                         | .....    | .....     | 2       |
| U.S.A. citizens.....   | 26      | 18       | 8         | 52      | 915            | 959      | 201       | 2,075   | 941                       | 977      | 209       | 2,127   |
| Hindoo.....            | 5       | 1        | .....     | 6       | 1              | .....    | .....     | 1       | 6                         | 1        | .....     | 7       |
| Total immigration..... | 18,452  | 14,446   | 11,172    | 44,070  | 3,473          | 3,147    | 1,648     | 8,268   | 21,925                    | 17,593   | 12,820    | 52,238  |
| Returned Canadian..... | 5,910   | 3,095    | 1,108     | 10,113  | .....          | .....    | .....     | .....   | 5,910                     | 3,095    | 1,108     | 10,113  |
| Tourist.....           | 1,065   | 944      | 66        | 2,015   | 26             | 27       | 1         | 54      | 1,031                     | 971      | 67        | 2,069   |
| Totals.....            | 25,367  | 18,485   | 12,346    | 56,198  | 3,499          | 3,174    | 1,649     | 8,322   | 28,866                    | 21,659   | 13,995    | 64,520  |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of Quebec, for the Fiscal Year ending March 31, 1909.

|                        | April. | May.   | June. | July. | August. | September. | October. | November. | Totals. |
|------------------------|--------|--------|-------|-------|---------|------------|----------|-----------|---------|
| African, South.....    |        | 3      | 2     | 4     | 1       | 11         | 8        | 1         | 30      |
| Australian.....        |        | 10     | 12    | 7     | 8       | 3          | 3        | 1         | 44      |
| Austrian, N.E.S.....   | 1      | 17     | 195   | 26    | 19      | 56         | 22       | 12        | 258     |
| Bohemian.....          |        | 5      | 2     | 2     | 7       | 1          | 1        | 15        | 15      |
| Bukowinian.....        |        | 165    | 66    | 11    | 3       | 13         |          | 3         | 261     |
| Croatian.....          |        | 1      |       |       |         |            |          |           | 1       |
| Galician.....          | 22     | 1,279  | 494   | 57    | 106     | 51         | 31       | 33        | 2,073   |
| Hungarian, N.E.S.....  |        | 13     | 9     | 16    | 8       | 1          | 6        | 7         | 60      |
| Belgian.....           | 22     | 135    | 50    | 24    | 29      | 37         | 37       | 9         | 343     |
| Bulgarian.....         | 1      | 19     | 1     |       | 1       |            |          |           | 22      |
| Chinese.....           |        | 1      | 2     | 1     | 16      |            |          |           | 20      |
| Dutch.....             | 15     | 75     | 31    | 35    | 16      | 36         | 18       | 3         | 229     |
| French.....            | 7      | 361    | 159   | 146   | 118     | 120        | 97       | 36        | 1,044   |
| German, N.E.S.....     | 7      | 120    | 86    | 58    | 54      | 57         | 72       | 41        | 495     |
| Prussian.....          |        |        |       |       | 3       |            |          |           | 3       |
| Saxon.....             |        |        |       |       |         | 8          |          |           | 8       |
| English.....           | 1,149  | 7,285  | 4,331 | 3,265 | 2,474   | 2,123      | 2,014    | 820       | 23,461  |
| Welsh.....             | 3      | 60     | 48    | 38    | 37      | 46         | 31       | 14        | 277     |
| Scotch.....            | 616    | 2,066  | 2,295 | 810   | 715     | 1,035      | 588      | 241       | 8,364   |
| Irish.....             | 85     | 597    | 476   | 344   | 395     | 308        | 177      | 116       | 2,408   |
| West Indian.....       |        | 599    | 1     |       |         | 1          |          |           | 2       |
| Bermudian.....         |        |        |       | 2     |         |            |          |           | 2       |
| Greek.....             | 7      |        | 5     | 9     | 14      | 3          |          |           | 38      |
| Hebrew, N.E.S.....     |        | 21     | 25    | 11    | 19      |            | 2        | 12        | 90      |
| "    Russian.....      |        | 12     | 147   | 167   | 187     | 123        | 156      | 60        | 895     |
| "    Polish.....       |        |        |       | 1     |         |            |          |           | 1       |
| "    Austrian.....     |        | 6      | 2     |       |         | 4          |          | 1         | 13      |
| "    German.....       |        | 4      |       |       |         |            |          | 7         | 11      |
| Italian.....           | 2      | 135    | 26    | 17    | 21      | 20         | 7        | 7         | 235     |
| Japanese.....          |        |        |       |       |         |            |          | 2         | 2       |
| Newfoundland.....      |        |        |       |       |         | 2          |          |           | 2       |
| New Zealand.....       | 2      | 2      | 1     | 3     | 3       |            | 1        |           | 12      |
| Polish, N.E.S.....     |        | 6      | 21    | 2     | 2       | 4          | 5        | 1         | 41      |
| "    Austrian.....     | 3      | 3      |       |       | 4       |            |          |           | 10      |
| "    German.....       |        | 1      |       |       |         |            |          |           | 1       |
| "    Russian.....      | 8      | 38     | 69    | 20    | 13      | 4          | 6        | 5         | 163     |
| Persian.....           |        |        |       |       | 1       |            |          |           | 1       |
| Roumanian.....         |        | 17     | 18    | 33    | 4       | 2          | 16       | 4         | 94      |
| Russian, N.E.S.....    | 72     | 375    | 298   | 197   | 101     | 98         | 115      | 179       | 1,435   |
| Finnish.....           |        | 29     | 25    | 44    | 39      | 41         | 49       | 24        | 251     |
| Spanish.....           |        |        | 2     | 6     | 1       | 2          | 2        |           | 13      |
| Swiss.....             | 1      | 24     | 8     | 8     | 5       | 13         | 8        | 3         | 70      |
| Servian.....           |        | 1      |       |       |         |            |          |           | 1       |
| Danish.....            |        | 18     | 10    | 10    | 2       | 6          | 6        | 4         | 56      |
| Icelandic.....         | 5      | 2      | 10    | 3     | 2       |            | 8        |           | 30      |
| Swedish.....           | 13     | 162    | 113   | 121   | 75      | 101        | 55       | 23        | 663     |
| Norwegian.....         | 4      | 67     | 74    | 57    | 64      | 67         | 48       | 15        | 396     |
| Turkish.....           |        |        | 1     |       |         |            | 1        |           | 2       |
| Armenian.....          |        |        |       | 6     |         | 1          | 5        | 1         | 13      |
| Syrian.....            |        | 3      | 19    | 27    |         |            | 2        |           | 51      |
| Arabian.....           |        |        |       |       | 1       |            | 1        |           | 2       |
| U. S. A. citizens..... | 6      | 14     | 6     | 7     | 15      | 2          | 1        | 1         | 52      |
| Hindoo.....            |        | 2      | 2     | 1     |         |            | 1        |           | 6       |
| Totals.....            | 2,093  | 13,224 | 9,075 | 5,646 | 4,129   | 4,430      | 3,504    | 1,669     | 44,070  |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Destination, at the Port of Quebec, for the Fiscal Year ending March 31, 1909.

|                              | April.       | May.          | June.        | July.        | August.      | September.   | October.     | November.    | Totals.       |
|------------------------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| Agriculturists . . . . .     | 656          | 4,369         | 3,063        | 1,636        | 1,134        | 819          | 736          | 386          | 12,799        |
| General labourers . . . . .  | 300          | 1,970         | 1,080        | 617          | 483          | 388          | 343          | 260          | 5,441         |
| Mechanics . . . . .          | 673          | 3,481         | 2,435        | 1,617        | 1,258        | 1,744        | 1,081        | 459          | 12,748        |
| Clerks . . . . .             | 249          | 1,234         | 891          | 535          | 485          | 427          | 343          | 169          | 4,333         |
| Miners . . . . .             | 31           | 247           | 182          | 162          | 149          | 181          | 150          | 58           | 1,163         |
| Female servants . . . . .    | 140          | 883           | 917          | 503          | 475          | 508          | 467          | 247          | 4,149         |
| Not classified . . . . .     | 44           | 1,049         | 507          | 576          | 445          | 360          | 384          | 96           | 3,446         |
| <b>Totals . . . . .</b>      | <b>2,093</b> | <b>13,224</b> | <b>9,075</b> | <b>5,646</b> | <b>4,429</b> | <b>4,430</b> | <b>3,504</b> | <b>1,669</b> | <b>44,070</b> |
| Maritime Provinces . . . . . | 29           | 209           | 89           | 118          | 85           | 90           | 84           | 27           | 731           |
| Quebec . . . . .             | 505          | 3,009         | 1,736        | 1,133        | 999          | 1,474        | 837          | 488          | 10,181        |
| Ontario . . . . .            | 836          | 4,598         | 2,945        | 2,034        | 1,591        | 1,271        | 1,263        | 506          | 15,938        |
| Manitoba . . . . .           | 338          | 2,335         | 1,715        | 886          | 661          | 595          | 411          | 248          | 7,189         |
| Saskatchewan . . . . .       | 124          | 1,069         | 968          | 487          | 344          | 291          | 254          | 85           | 3,622         |
| Alberta . . . . .            | 119          | 1,006         | 727          | 481          | 365          | 274          | 262          | 113          | 3,347         |
| British Columbia . . . . .   | 148          | 998           | 895          | 507          | 384          | 433          | 393          | 202          | 3,960         |
| Yukon . . . . .              | .....        | .....         | .....        | .....        | .....        | 2            | .....        | .....        | 2             |
| <b>Totals . . . . .</b>      | <b>2,093</b> | <b>13,224</b> | <b>9,075</b> | <b>5,646</b> | <b>4,429</b> | <b>4,430</b> | <b>3,504</b> | <b>1,669</b> | <b>44,070</b> |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant Arrivals for

|                    | SEX.   |          |           |         | TRADE OR                         |          |           |                    |          |           |            |          |           |
|--------------------|--------|----------|-----------|---------|----------------------------------|----------|-----------|--------------------|----------|-----------|------------|----------|-----------|
|                    |        |          |           |         | Farmers or Farm Labourers Class. |          |           | General Labourers. |          |           | Mechanics. |          |           |
|                    | Males. | Females. | Children. | Totals. | Males.                           | Females. | Children. | Males.             | Females. | Children. | Males.     | Females. | Children. |
| African, South..   | 12     | 9        | 9         | 30      | 6                                | 1        | 2         | 1                  | ..       | ..        | 4          | 4        | 4         |
| Australian .....   | 25     | 11       | 8         | 44      | 13                               | 3        | 1         | 2                  | ..       | ..        | 6          | 5        | 5         |
| Austrian, N. E. S. | 143    | 57       | 58        | 258     | 49                               | 13       | 23        | 49                 | 7        | 9         | 19         | 15       | 14        |
| Bohemian .....     | 3      | 5        | 7         | 15      | ..                               | ..       | ..        | ..                 | ..       | ..        | 1          | 1        | 1         |
| Bukowinian .....   | 191    | 36       | 34        | 261     | 88                               | 15       | 28        | 76                 | 2        | 2         | 12         | 4        | 3         |
| Croatian .....     | 1      | ..       | ..        | 1       | ..                               | ..       | ..        | 1                  | ..       | ..        | ..         | ..       | ..        |
| Galician .....     | 1,220  | 375      | 478       | 2,073   | 661                              | 201      | 418       | 447                | 33       | 36        | 66         | 18       | 15        |
| Hung'rn, N. E. S.  | 27     | 15       | 18        | 60      | 18                               | 4        | 6         | 3                  | 1        | 3         | 3          | 2        | 5         |
| Belgian .....      | 164    | 93       | 86        | 343     | 63                               | 26       | 42        | 15                 | 4        | 1         | 28         | 18       | 15        |
| Bulgarian .....    | 20     | 2        | ..        | 22      | 17                               | 1        | ..        | ..                 | ..       | ..        | 3          | ..       | ..        |
| Chinese .....      | 20     | ..       | ..        | 20      | ..                               | ..       | ..        | 4                  | ..       | ..        | ..         | ..       | ..        |
| Dutch .....        | 97     | 69       | 63        | 229     | 50                               | 31       | 36        | 7                  | 4        | 3         | 23         | 11       | 18        |
| French .....       | 617    | 296      | 131       | 1,044   | 340                              | 85       | 73        | 23                 | 10       | 3         | 116        | 59       | 29        |
| German, N. E. S.   | 246    | 128      | 121       | 495     | 97                               | 41       | 63        | 44                 | 11       | 13        | 68         | 22       | 32        |
| Prussian .....     | 2      | 1        | ..        | 3       | 1                                | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| Saxon .....        | 1      | ..       | 7         | 8       | ..                               | 1        | 7         | ..                 | ..       | ..        | ..         | ..       | ..        |
| English .....      | 9,163  | 7,969    | 6,329     | 23,461  | 3,351                            | 1,374    | 1,242     | 1,196              | 689      | 807       | 2,919      | 2,308    | 2,203     |
| Welsh .....        | 116    | 89       | 72        | 277     | 37                               | 14       | 21        | 8                  | 8        | 7         | 40         | 29       | 33        |
| Scotch .....       | 3,412  | 3,024    | 1,928     | 8,364   | 1,114                            | 377      | 388       | 335                | 185      | 221       | 1,347      | 840      | 863       |
| Irish .....        | 1,037  | 923      | 443       | 2,408   | 468                              | 108      | 107       | 133                | 42       | 61        | 183        | 126      | 110       |
| West Indian .....  | 2      | ..       | ..        | 2       | 1                                | ..       | ..        | ..                 | ..       | ..        | 1          | ..       | ..        |
| Bermudian .....    | ..     | 1        | 1         | 2       | ..                               | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| Greek .....        | 29     | 4        | 5         | 38      | 2                                | ..       | ..        | 14                 | 1        | 1         | 6          | ..       | ..        |
| Hebrew, N. E. S.   | 37     | 26       | 27        | 90      | 5                                | 1        | ..        | 3                  | ..       | ..        | 20         | 17       | 21        |
| " Russian ..       | 248    | 318      | 329       | 895     | 41                               | 24       | 22        | 44                 | 18       | 26        | 135        | 169      | 191       |
| " Polish .....     | 1      | ..       | ..        | 1       | 1                                | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| " Austrian ..      | 4      | 3        | 6         | 13      | ..                               | ..       | ..        | 2                  | ..       | ..        | 2          | 2        | 3         |
| " German .....     | 3      | 4        | 4         | 11      | 1                                | 1        | 2         | ..                 | ..       | ..        | 2          | ..       | ..        |
| Italian .....      | 201    | 24       | 10        | 235     | 21                               | 2        | 2         | 135                | 5        | 1         | 18         | 6        | 4         |
| Japanese .....     | 2      | ..       | ..        | 2       | 2                                | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| Newfoundland ..    | 2      | ..       | ..        | 2       | ..                               | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| New Zealand .....  | 7      | 4        | 1         | 12      | 4                                | ..       | ..        | 2                  | ..       | ..        | 1          | 1        | 1         |
| Polish, N. E. S.   | 22     | 10       | 9         | 41      | 10                               | ..       | ..        | 6                  | 2        | 3         | 3          | 5        | 3         |
| " Austrian ..      | 8      | 1        | 1         | 10      | 3                                | 1        | 1         | 4                  | ..       | ..        | 1          | ..       | ..        |
| " German .....     | 1      | ..       | ..        | 1       | 1                                | ..       | ..        | ..                 | ..       | ..        | ..         | ..       | ..        |
| " Russian .....    | 81     | 42       | 40        | 163     | 41                               | 13       | 18        | 24                 | 7        | 6         | 9          | 9        | 13        |
| Persian .....      | 1      | ..       | ..        | 1       | ..                               | ..       | ..        | 1                  | ..       | ..        | ..         | ..       | ..        |
| Roumanian .....    | 25     | 36       | 33        | 94      | 8                                | 6        | 13        | 3                  | ..       | ..        | 12         | 13       | 11        |
| Russian, N. E. S.  | 503    | 371      | 561       | 1,435   | 263                              | 167      | 314       | 129                | 51       | 119       | 68         | 60       | 70        |
| Finnish .....      | 102    | 93       | 56        | 251     | 15                               | 6        | 10        | 44                 | 20       | 22        | 15         | 9        | 15        |
| Spanish .....      | 12     | 1        | ..        | 13      | ..                               | ..       | ..        | ..                 | ..       | ..        | 4          | 1        | ..        |
| Swiss .....        | 45     | 15       | 10        | 70      | 26                               | 3        | 6         | 3                  | ..       | ..        | 11         | 2        | ..        |
| Servian .....      | 1      | ..       | ..        | 1       | ..                               | ..       | ..        | 1                  | ..       | ..        | ..         | ..       | ..        |
| Danish .....       | 31     | 18       | 4         | 56      | 25                               | 5        | 4         | 4                  | ..       | ..        | 4          | 1        | ..        |
| Icelandic .....    | 14     | 12       | 4         | 30      | 7                                | 5        | 2         | 2                  | 1        | ..        | 3          | 1        | ..        |
| Swedish .....      | 303    | 198      | 162       | 663     | 168                              | 71       | 94        | 76                 | 19       | 23        | 44         | 17       | 24        |
| Norwegian .....    | 176    | 121      | 99        | 396     | 111                              | 36       | 58        | 35                 | 15       | 19        | 15         | 13       | 20        |
| Turkish .....      | 2      | ..       | ..        | 2       | ..                               | ..       | ..        | ..                 | ..       | ..        | 1          | ..       | ..        |
| Armenian .....     | 4      | 5        | 4         | 13      | 2                                | 4        | 4         | 1                  | ..       | ..        | 1          | 1        | ..        |
| Syrian .....       | 33     | 12       | 6         | 51      | 11                               | ..       | ..        | 8                  | 2        | 3         | 4          | 2        | 1         |
| Arabian .....      | 2      | ..       | ..        | 2       | ..                               | ..       | ..        | 1                  | ..       | ..        | ..         | ..       | ..        |
| U. S. A. citizens. | 26     | 18       | 8         | 52      | 4                                | 2        | 1         | 7                  | ..       | 1         | 5          | 3        | ..        |
| Hindoo .....       | 5      | 1        | ..        | 6       | ..                               | ..       | ..        | ..                 | ..       | ..        | 1          | ..       | ..        |
| Totals .....       | 18,452 | 14,446   | 11,172    | 44,070  | 7,146                            | 2,645    | 3,008     | 2,913              | 1,138    | 1,390     | 5,224      | 3,797    | 3,727     |

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V.

Canada at the Port of Quebec, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.             |          |           |         |          |           |                  |                 |          | DESTINATION. |                        |         |          |           |               |          |                   |        |  |
|-------------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|--------------|------------------------|---------|----------|-----------|---------------|----------|-------------------|--------|--|
| Clerks,<br>Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |              | Maritime<br>Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. | Yukon. |  |
| Males.                  | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children.    |                        |         |          |           |               |          |                   |        |  |
| 2                       | 1        | 2         |         |          |           | 1                | 1               | 2        | 3            | 3                      | 16      | 1        |           | 3             | 7        |                   |        |  |
| 5                       | 1        | 1         | 21      | 7        | 10        | 13               | 1               | 1        | 12           | 55                     | 23      | 66       | 32        | 43            | 27       |                   |        |  |
|                         |          |           | 15      | 1        | 1         | 14               |                 |          | 5            | 49                     | 42      | 94       | 50        | 10            | 11       |                   |        |  |
| 1                       |          |           | 42      | 2        | 1         | 114              | 3               | 7        | 8            | 19                     | 258     | 286      | 854       | 381           | 245      | 30                |        |  |
|                         | 1        | 1         | 3       | 2        |           | 3                | 2               | 3        | 3            | 11                     | 12      | 9        | 23        | 5             |          |                   |        |  |
| 6                       | 3        | 1         | 47      | 21       | 21        | 12               | 5               | 9        | 6            | 76                     | 96      | 11       | 110       | 14            | 21       | 15                |        |  |
|                         |          |           |         |          |           | 1                | 2               |          |              | 2                      | 2       | 5        | 12        | 2             | 1        |                   |        |  |
| 14                      |          |           |         |          |           |                  | 2               |          |              | 19                     | 1       |          |           |               |          |                   |        |  |
| 8                       | 3        | 3         |         |          |           | 10               | 9               | 4        | 3            | 1                      | 29      | 30       | 47        | 32            | 59       | 31                |        |  |
| 54                      | 19       | 8         | 13      | 3        | 5         | 56               | 71              | 64       | 13           | 20                     | 588     | 49       | 213       | 103           | 55       | 16                |        |  |
| 20                      | 10       |           | 10      | 5        | 8         | 32               | 7               | 7        | 5            | 4                      | 117     | 32       | 161       | 82            | 56       | 43                |        |  |
|                         |          |           |         |          |           | 1                | 1               |          |              |                        | 2       |          |           |               |          | 1                 |        |  |
| 1,043                   | 874      | 533       | 191     | 139      | 191       | 2,012            | 463             | 573      | 1,353        | 370                    | 4,904   | 9,859    | 2,739     | 1,670         | 1,631    | 2,288             |        |  |
| 13                      | 8        | 3         | 15      | 7        | 6         | 18               | 3               | 5        | 2            | 1                      | 52      | 70       | 48        | 15            | 27       | 64                |        |  |
| 419                     | 367      | 239       | 103     | 36       | 53        | 1,070            | 74              | 149      | 164          | 117                    | 2,048   | 2,671    | 1,311     | 513           | 674      | 1,028             |        |  |
| 185                     | 116      | 77        | 13      | 6        | 7         | 435              | 55              | 95       | 81           | 36                     | 620     | 864      | 447       | 101           | 174      | 166               |        |  |
|                         |          |           |         |          |           | 1                |                 |          | 1            |                        | 1       |          |           |               |          | 1                 |        |  |
| 2                       | 2        | 3         |         |          |           | 1                | 5               |          | 1            |                        | 18      | 14       | 1         |               |          | 5                 |        |  |
| 8                       | 2        | 6         |         |          |           | 6                | 1               |          |              |                        | 70      | 12       | 5         | 3             |          |                   |        |  |
| 22                      | 45       | 72        | 2       | 1        |           | 49               | 4               | 12       | 18           | 9                      | 374     | 273      | 196       | 25            | 4        | 14                |        |  |
|                         | 1        | 3         |         |          |           | 2                |                 |          |              |                        | 10      | 3        |           |               |          |                   |        |  |
|                         | 1        | 2         |         |          |           | 2                |                 |          |              |                        | 5       | 6        |           |               |          |                   |        |  |
| 4                       | 1        | 1         | 19      | 1        |           | 5                | 4               | 4        | 2            | 21                     | 161     | 38       | 4         |               | 5        | 6                 |        |  |
|                         |          |           |         |          |           |                  | 2               |          |              |                        | 2       |          |           |               |          |                   |        |  |
|                         |          |           |         |          |           | 1                |                 | 2        |              | 2                      | 2       | 1        | 3         |               | 1        | 3                 |        |  |
|                         |          |           | 2       | 1        | 1         | 1                | 1               | 1        | 2            | 4                      | 20      | 4        | 9         | 3             | 1        |                   |        |  |
|                         |          |           |         |          |           |                  |                 |          |              |                        | 1       | 1        | 7         | 1             |          |                   |        |  |
|                         | 2        |           | 7       | 2        | 3         | 8                |                 | 1        |              | 9                      | 59      | 19       | 37        | 26            | 11       | 2                 |        |  |
|                         |          |           |         |          |           |                  |                 |          |              |                        |         | 1        | 7         |               |          |                   |        |  |
| 1                       | 5        | 5         |         |          |           | 7                | 1               | 5        | 4            |                        | 66      | 5        | 7         | 16            |          |                   |        |  |
| 9                       | 14       | 18        | 23      | 2        | 5         | 59               | 11              | 18       | 35           | 15                     | 266     | 159      | 514       | 333           | 122      | 26                |        |  |
| 1                       |          |           | 27      | 8        | 6         | 47               |                 | 3        | 3            |                        | 25      | 171      | 13        | 1             | 18       | 23                |        |  |
| 1                       |          |           | 2       |          |           |                  | 5               |          |              |                        | 10      | 2        | 1         |               |          |                   |        |  |
| 2                       | 2        |           |         |          |           | 6                | 3               | 2        | 4            | 1                      | 29      | 7        | 15        | 5             | 3        | 10                |        |  |
|                         |          |           |         |          |           |                  |                 |          |              |                        |         |          |           |               |          | 1                 |        |  |
| 1                       | 1        |           |         |          |           | 11               |                 |          |              | 1                      | 17      | 13       | 9         | 5             | 9        | 2                 |        |  |
| 2                       |          |           |         |          |           | 5                |                 |          | 2            |                        | 2       |          | 25        | 3             |          |                   |        |  |
| 1                       | 1        | 1         | 13      | 3        | 9         | 83               | 1               | 4        | 11           | 3                      | 59      | 219      | 149       | 101           | 67       | 65                |        |  |
| 2                       | 1        |           | 10      |          |           | 52               | 3               | 4        | 2            | 2                      | 41      | 73       | 58        | 76            | 91       | 55                |        |  |
| 1                       |          |           |         |          |           |                  |                 |          |              |                        | 2       |          |           |               |          |                   |        |  |
| 9                       | 6        | 2         |         |          |           | 2                | 1               |          |              | 2                      | 1       | 7        |           |               | 5        |                   |        |  |
| 1                       |          |           |         |          |           |                  |                 |          |              | 1                      | 40      | 9        |           |               |          |                   |        |  |
| 7                       | 9        | 6         | 1       |          |           | 2                | 2               | 1        |              | 1                      | 25      | 11       |           |               |          | 2                 |        |  |
| 4                       |          |           |         |          |           |                  |                 | 1        |              |                        | 2       | 3        | 1         |               |          |                   |        |  |
| 1,848                   | 1,498    | 987       | 581     | 250      | 332       | 4,140            | 740             | 978      | 1,728        | 731                    | 10,181  | 15,038   | 7,189     | 3,622         | 3,347    | 3,960             |        |  |

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## PORT OF VANCOUVER.

For the fiscal year 1908-9, there arrived at the port of Vancouver 8,651 passengers, of whom 1,755 travelled saloon and 6,896 steerage. Of the saloon passengers, 1,278 were destined to Canada and 477 to the United States. Of the steerage passengers, 5,121 were for Canada and 1,775 for the United States. Included in the steerage passengers for Canada were 1,446 returned Canadians and 2,158 tourists, leaving the immigration proper at 1,517 souls, a decrease as compared with the preceding fiscal year of 5,049 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of Vancouver, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....    |         |          | 1         | 1       |                |          |           |         |                           |          | 1         | 1       |
| Australian.....        | 62      | 81       | 22        | 165     | 22             | 15       | 5         | 42      | 84                        | 96       | 27        | 207     |
| Austrian.....          | 2       |          |           | 2       | 1              |          |           | 1       | 3                         |          |           | 3       |
| Belgian.....           | 2       |          |           | 2       | 1              |          |           | 1       | 3                         |          |           | 3       |
| Chinese.....           | 5       |          | 1         | 6       | 5              | 3        |           | 8       | 10                        | 3        | 1         | 14      |
| Dutch.....             | 8       | 1        |           | 9       |                |          |           |         | 8                         | 1        |           | 9       |
| French.....            | 7       | 8        |           | 15      | 8              | 2        |           | 10      | 15                        | 10       |           | 25      |
| German.....            | 21      | 6        |           | 27      | 6              | 6        |           | 12      | 27                        | 12       |           | 39      |
| English.....           | 345     | 164      | 35        | 544     | 37             | 13       | 2         | 52      | 382                       | 177      | 37        | 596     |
| Welsh.....             | 2       | 1        |           | 3       | 1              | 1        |           | 2       | 3                         | 2        |           | 5       |
| Scotch.....            | 58      | 29       | 1         | 88      | 4              | 2        |           | 6       | 62                        | 31       | 1         | 94      |
| Irish.....             | 19      | 12       |           | 31      | 3              | 2        |           | 5       | 22                        | 14       |           | 36      |
| West Indian.....       | 4       | 1        | 3         | 8       | 1              | 1        |           | 2       | 5                         | 2        | 3         | 10      |
| Italian.....           | 2       |          |           | 2       |                | 1        |           | 1       | 2                         | 1        |           | 3       |
| Japanese.....          | 16      | 5        | 3         | 24      | 5              | 5        | 2         | 12      | 21                        | 10       | 5         | 36      |
| Newfoundland.....      | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| New Zealand.....       | 37      | 36       | 3         | 76      | 9              | 4        |           | 13      | 46                        | 40       | 3         | 89      |
| Portuguese.....        | 3       |          |           | 3       |                |          |           |         | 3                         |          |           | 3       |
| Russian.....           | 5       | 2        |           | 7       | 1              |          |           | 1       | 6                         | 2        |           | 8       |
| Spanish.....           | 4       |          |           | 4       |                |          |           |         | 4                         |          |           | 4       |
| Swiss.....             | 1       |          |           | 1       | 1              |          |           | 1       | 2                         |          |           | 2       |
| Swedish.....           | 3       |          |           | 3       | 1              |          |           | 1       | 4                         |          |           | 4       |
| Norwegian.....         |         | 1        |           | 1       |                | 1        |           | 1       |                           | 2        |           | 2       |
| Egyptian.....          | 1       |          |           | 1       |                |          |           |         | 1                         |          |           | 1       |
| U. S. A. Citizens..... | 40      | 18       | 9         | 67      | 109            | 120      | 47        | 276     | 149                       | 138      | 56        | 343     |
| Hindoo.....            | 2       |          |           | 2       |                |          |           |         | 2                         |          |           | 2       |
| Canadian.....          | 63      | 45       | 15        | 123     | 4              | 1        | 3         | 8       | 67                        | 46       | 18        | 131     |
| Tourist.....           | 38      | 21       | 3         | 62      | 13             | 6        | 3         | 22      | 51                        | 27       | 6         | 84      |
| Totals.....            | 751     | 431      | 96        | 1,278   | 232            | 183      | 62        | 477     | 983                       | 614      | 168       | 1,755   |



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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of Vancouver, for the Fiscal Year ending March 31, 1909.

|                       | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|-----------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                       | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African South....     |         |          |           |         | 2              | 2        | 6         | 10      | 2                         | 2        | 6         | 10      |
| Anstralian.....       | 49      | 27       | 23        | 99      | 27             | 27       | 17        | 71      | 76                        | 54       | 40        | 170     |
| Austrian.....         |         |          |           |         | 4              |          |           | 4       | 4                         |          |           | 4       |
| Belgian.....          | 2       |          |           | 2       |                |          |           | 2       | 2                         |          |           | 2       |
| Chinese.....          | 973     | 18       | 78        | 1,071   | 129            | 4        | 2         | 135     | 1,107                     | 22       | 80        | 1,209   |
| French.....           | 5       | 2        |           | 7       | 1              | 1        |           | 2       | 6                         | 3        |           | 9       |
| German.....           | 4       |          |           | 4       | 1              |          |           | 1       | 5                         |          |           | 5       |
| English.....          | 86      | 19       | 5         | 110     | 23             | 14       | 1         | 38      | 109                       | 33       | 6         | 148     |
| Welsh.....            | 2       | 1        |           | 3       | 1              |          |           | 1       | 3                         | 1        |           | 4       |
| Scotch.....           | 32      | 8        | 2         | 42      | 11             | 2        |           | 13      | 13                        | 10       | 2         | 25      |
| Irish.....            | 10      | 5        |           | 15      | 7              | 3        |           | 10      | 17                        | 8        |           | 25      |
| West Indian.....      | 2       | 1        | 2         | 5       |                | 1        |           | 1       | 2                         | 2        | 2         | 6       |
| Greek.....            | 2       |          |           | 2       |                |          |           | 2       | 2                         |          |           | 2       |
| Japanese.....         | 30      | 6        | 1         | 37      | 25             | 19       |           | 44      | 55                        | 25       | 1         | 81      |
| New Zealand.....      | 23      | 11       | 10        | 44      | 8              | 5        | 2         | 15      | 31                        | 16       | 12        | 59      |
| Russian.....          | 51      |          |           | 51      |                |          |           | 51      | 51                        |          |           | 51      |
| Spanish.....          |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Swiss.....            | 1       |          |           | 1       |                |          |           | 1       | 1                         |          |           | 1       |
| Danish.....           | 3       |          |           | 3       | 2              | 1        | 4         | 7       | 5                         | 1        | 4         | 10      |
| Swedish.....          | 2       |          |           | 2       | 4              |          |           | 4       | 6                         |          |           | 6       |
| Syrian.....           |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| U. S. A. citizens ..  | 11      | 5        |           | 16      | 64             | 24       | 8         | 96      | 75                        | 29       | 8         | 112     |
| Total immigration ... | 1,293   | 103      | 121       | 1,517   | 312            | 103      | 40        | 455     | 1,605                     | 296      | 161       | 1,972   |
| Returned Canadian.... | 1,386   | 31       | 29        | 1,446   |                |          |           |         | 1,386                     | 31       | 29        | 1,446   |
| Tourist.....          | 1,962   | 123      | 73        | 2,158   | 1,295          | 60       | 55        | 1,320   | 3,167                     | 183      | 128       | 3,478   |
| Totals.....           | 4,641   | 257      | 223       | 5,121   | 1,517          | 163      | 95        | 1,775   | 6,158                     | 420      | 318       | 6,896   |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of Vancouver, for the Fiscal Year ending March 31, 1909.

|                  | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Totals. |
|------------------|------|------|-------|-------|------|-------|------|------|------|------|------|------|---------|
| Australian.....  | 4    | 7    | 34    | 5     | 2    | 6     | 4    | 5    | 5    | 7    | 5    | 15   | 99      |
| Belgian.....     |      | 1    |       |       | 1    |       |      |      |      |      |      |      | 2       |
| Chinese.....     | 98   | 325  |       | 291   | 78   | 113   | 49   | 30   | 27   | 23   | 14   | 26   | 1,074   |
| French.....      |      |      | 1     |       |      | 1     |      |      |      |      |      |      | 5       |
| German.....      |      | 1    |       |       |      |       |      |      | 2    |      |      |      | 4       |
| English.....     | 11   | 16   | 28    | 5     | 2    | 15    | 1    | 8    | 3    | 10   | 3    | 8    | 110     |
| Welsh.....       | 1    |      |       |       |      | 1     |      |      |      | 1    |      |      | 3       |
| Scotch.....      | 4    | 7    | 7     | 2     | 1    | 4     |      | 7    | 2    | 5    |      |      | 42      |
| Irish.....       | 3    | 2    | 4     | 1     | 1    |       | 1    | 2    |      |      |      | 1    | 15      |
| West Indian..... |      |      |       |       | 4    |       |      |      |      |      | 1    |      | 5       |
| Greek.....       |      |      | 2     |       |      |       |      |      |      |      |      |      | 2       |
| Japanese.....    | 9    | 14   | 3     |       | 1    | 3     | 4    |      | 1    |      | 2    |      | 37      |
| New Zealand..... | 8    | 4    | 20    |       | 1    |       |      |      |      |      | 3    |      | 44      |
| Russian.....     |      |      | 1     |       |      |       |      |      |      |      |      | 50   | 51      |
| Swiss.....       |      |      |       |       |      | 1     |      |      |      |      |      |      | 1       |
| Danish.....      |      |      |       | 1     |      |       |      | 1    |      | 1    |      |      | 3       |
| Swedish.....     | 2    |      |       |       |      |       |      |      |      |      |      |      | 2       |
| U.S.A. citizens. | 1    |      | 4     |       |      | 1     |      |      | 2    | 1    | 4    | 3    | 16      |
| Totals.....      | 141  | 377  | 104   | 305   | 92   | 144   | 59   | 59   | 42   | 48   | 32   | 114  | 1,517   |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Destination, at the Port of Vancouver, for the Fiscal Year ending March 31, 1909.

|                              | April.     | May.       | June.      | July.      | Aug.      | Sept.      | Oct.      | Nov.      | Dec.      | Jan.      | Feb.      | Mar.       | Totals.      |
|------------------------------|------------|------------|------------|------------|-----------|------------|-----------|-----------|-----------|-----------|-----------|------------|--------------|
| Agriculturists . . . . .     | 15         | 11         | 12         | 1          | 1         | 1          | 1         | 3         | ...       | 9         | 1         | 2          | 57           |
| General labourers. . . . .   | 80         | 141        | 17         | 125        | 1         | 88         | 3         | 15        | 2         | 7         | 3         | 63         | 544          |
| Mechanics . . . . .          | 12         | 40         | 15         | 3          | 1         | 6          | 2         | 3         | 4         | 7         | 6         | 5          | 104          |
| Clerks. . . . .              | 21         | 151        | 24         | 152        | 64        | 34         | 32        | 20        | 25        | 15        | 12        | 11         | 561          |
| Miners . . . . .             | 1          | 4          | 5          | 1          | ...       | 3          | ...       | ...       | ...       | 2         | 1         | 7          | 24           |
| Female servants . . . . .    | ...        | 4          | 2          | 1          | ...       | 1          | 3         | ...       | 1         | 2         | ...       | ...        | 14           |
| Not classified. . . . .      | 12         | 26         | 29         | 22         | 25        | 11         | 18        | 18        | 10        | 6         | 9         | 27         | 213          |
| <b>Totals. . . . .</b>       | <b>141</b> | <b>377</b> | <b>104</b> | <b>305</b> | <b>92</b> | <b>114</b> | <b>59</b> | <b>59</b> | <b>42</b> | <b>48</b> | <b>32</b> | <b>114</b> | <b>1,517</b> |
| Maritime Provinces . . . . . | 1          | ...        | ...        | 5          | 3         | 2          | ...       | ...       | ...       | 1         | ...       | ...        | 12           |
| Quebec . . . . .             | 2          | 23         | ...        | 41         | 14        | 14         | 8         | 5         | 2         | 1         | 4         | ...        | 120          |
| Ontario . . . . .            | 26         | 37         | 14         | 63         | 12        | 22         | 8         | 10        | 4         | 4         | 1         | 3          | 204          |
| Manitoba. . . . .            | 1          | ...        | 5          | 10         | ...       | ...        | 1         | ...       | ...       | 1         | ...       | 2          | 20           |
| Saskatchewan. . . . .        | 3          | ...        | ...        | ...        | ...       | ...        | ...       | ...       | ...       | ...       | ...       | ...        | 3            |
| Alberta. . . . .             | 12         | 1          | 8          | ...        | 1         | 1          | ...       | 3         | ...       | 8         | 4         | 3          | 41           |
| British Columbia. . . . .    | 90         | 316        | 77         | 186        | 62        | 105        | 42        | 41        | 36        | 33        | 23        | 105        | 1,116        |
| Yukon. . . . .               | ...        | ...        | ...        | ...        | ...       | ...        | ...       | ...       | ...       | ...       | ...       | 1          | 1            |
| <b>Totals. . . . .</b>       | <b>141</b> | <b>377</b> | <b>101</b> | <b>305</b> | <b>92</b> | <b>144</b> | <b>59</b> | <b>59</b> | <b>42</b> | <b>48</b> | <b>32</b> | <b>114</b> | <b>1,517</b> |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals for

|                      | SEX.   |          |           |         | TRADE OR                               |          |           |                    |          |           |            |          |           |
|----------------------|--------|----------|-----------|---------|--|----------|-----------|--------------------|----------|-----------|------------|----------|-----------|
|                      |        |          |           |         | Farmers or<br>Farm Labourers<br>Class. |          |           | General Labourers. |          |           | Mechanics. |          |           |
|                      | Males. | Females. | Children. | Totals. | Males.                                 | Females. | Children. | Males.             | Females. | Children. | Males.     | Females. | Children. |
| Australian.....      | 49     | 27       | 23        | 99      | 3                                      | 2        | 4         | 14                 |          |           | 10         | 2        |           |
| Belgian.....         | 2      |          |           | 2       |  |          |           | 1                  |          |           |            |          |           |
| Chinese.....         | 978    | 18       | 78        | 1,074   |  |          |           | 429                |          | 6         | 34         |          |           |
| French.....          | 5      | 12       |           | 17      |  |          |           | 2                  |          |           |            |          |           |
| German.....          | 4      |          |           | 4       | 1                                      |          |           |                    |          |           |            |          |           |
| English.....         | 86     | 19       | 5         | 110     | 15                                     | 1        |           | 15                 | 4        |           | 18         |          |           |
| Welsh.....           | 2      | 1        |           | 3       | 1                                      |          |           |                    |          |           |            |          |           |
| Scotch.....          | 32     | 2        | 2         | 42      | 7                                      |          |           | 6                  |          |           | 9          | 1        | 1         |
| Irish.....           | 10     | 5        |           | 15      | 1                                      |          |           | 2                  |          |           | 6          |          |           |
| West Indian.....     | 2      | 1        | 2         | 5       |  |          |           |                    |          |           | 1          |          |           |
| Greek.....           | 2      |          |           | 2       | 1                                      |          |           | 1                  |          |           |            |          |           |
| Japanese.....        | 30     | 6        | 1         | 37      | 12                                     |          |           | 6                  | 1        |           | 1          | 1        | 1         |
| New Zealand.....     | 23     | 11       | 10        | 44      | 3                                      | 1        | 2         | 3                  |          |           | 9          |          |           |
| Russian.....         | 51     |          |           | 51      |  |          |           | 50                 |          |           |            |          |           |
| Swiss.....           | 1      |          |           | 1       |  |          |           | 1                  |          |           |            |          |           |
| Danish.....          | 3      |          |           | 3       | 1                                      |          |           | 1                  |          |           | 1          |          |           |
| Swedish.....         | 2      |          |           | 2       |  |          |           |                    |          |           | 1          |          |           |
| U.S.A. citizens..... | 11     | 5        |           | 16      | 2                                      |          |           | 2                  |          |           | 3          | 1        |           |
| Totals.....          | 1,293  | 103      | 121       | 1,517   | 47                                     | 4        | 6         | 533                | 5        | 6         | 97         | 5        | 2         |

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V.

Canada at the Port of Vancouver, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.             |          |           |         |          |           |                  | DESTINATION.    |          |           |                        |         |          |           |               |          |                      |        |
|-------------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|-----------|------------------------|---------|----------|-----------|---------------|----------|----------------------|--------|
| Clerks,<br>Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not classified. |          |           | Maritime<br>Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British<br>Columbia. | Yukon. |
| Males.                  | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children. |                        |         |          |           |               |          |                      |        |
| 13                      | 3        | 5         | 4       | 1        | .....     | 5                | 5               | 14       | 14        | .....                  | .....   | 6        | 4         | .....         | 10       | 7                    | 1      |
| 481                     | 3        | 8         | 1       | .....    | .....     | 33               | 1               | 15       | 64        | 10                     | 117     | 175      | 9         | .....         | 2        | 761                  | .....  |
| .....                   | .....    | .....     | .....   | .....    | .....     | 1                | 1               | 2        | .....     | .....                  | .....   | .....    | .....     | .....         | .....    | 4                    | .....  |
| 18                      | 3        | .....     | 11      | .....    | .....     | 1                | 9               | 9        | 5         | 2                      | 2       | 16       | 5         | 2             | .....    | 7                    | 76     |
| 6                       | 2        | .....     | 3       | .....    | .....     | 3                | 1               | 2        | 1         | .....                  | 1       | 2        | 1         | .....         | .....    | 1                    | 1      |
| 1                       | .....    | .....     | .....   | .....    | .....     | 1                | 1               | 4        | 1         | .....                  | .....   | 1        | .....     | .....         | 2        | 39                   | .....  |
| .....                   | .....    | .....     | .....   | .....    | .....     | 1                | 1               | 1        | 2         | .....                  | .....   | .....    | .....     | .....         | .....    | 12                   | .....  |
| .....                   | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | .....                  | .....   | .....    | .....     | .....         | .....    | 5                    | .....  |
| 7                       | 2        | .....     | .....   | .....    | .....     | .....            | 4               | 2        | .....     | .....                  | .....   | 1        | 1         | .....         | 11       | 24                   | .....  |
| 3                       | 2        | .....     | 3       | .....    | .....     | 2                | 2               | 6        | 8         | .....                  | .....   | 3        | .....     | 1             | 7        | 33                   | .....  |
| 1                       | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | .....                  | .....   | .....    | .....     | .....         | .....    | 51                   | .....  |
| .....                   | .....    | .....     | .....   | .....    | .....     | .....            | .....           | .....    | .....     | .....                  | .....   | .....    | .....     | .....         | 1        | 1                    | .....  |
| .....                   | .....    | .....     | 1       | .....    | .....     | .....            | .....           | .....    | .....     | .....                  | .....   | .....    | .....     | .....         | .....    | 2                    | .....  |
| 2                       | 1        | .....     | .....   | .....    | .....     | .....            | 2               | 3        | .....     | .....                  | .....   | .....    | .....     | .....         | .....    | 2                    | .....  |
| 532                     | 16       | 13        | 23      | 1        | .....     | 14               | 61              | 58       | 94        | 12                     | 120     | 204      | 20        | 3             | 41       | 1,116                | 1      |

9-10 EDWARD VII., A. 1910

## PORT OF VICTORIA.

For the fiscal year 1908-9, there arrived at the port of Victoria 4,260 passengers, of whom 395 travelled saloon and 3,865 steerage. Of the saloon passengers, 267 were destined to Canada and 128 to the United States. Of the steerage passengers, 3,285 were for Canada and 580 for the United States. Included in the steerage passengers for Canada were 1,953 returned Canadians and 30 tourists, leaving the immigration proper at 1,302 souls, a decrease as compared with the preceding fiscal year of 4,722 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants for Canada, and Tables IV. and V. give summaries of the information obtained from immigrants for Canada upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers arriving at the Port of Victoria, for the Fiscal Year ending March 31, 1909.

|                           | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|---------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                           | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| Australian.. . . . .      | 5       | 3        |           | 8       | 2              | 2        |           | 4       | 7                         | 5        |           | 12      |
| Belgian.. . . . .         |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Chinese.. . . . .         | 4       | 1        | 4         | 9       |                |          |           |         | 4                         | 1        | 4         | 9       |
| French.. . . . .          | 1       | 3        |           | 4       | 1              |          |           | 1       | 2                         | 3        |           | 5       |
| German.. . . . .          | 4       |          |           | 4       | 3              |          |           | 3       |                           |          |           | 7       |
| English.. . . . .         | 72      | 45       | 7         | 130     | 7              | 3        |           | 10      | 85                        | 48       | 7         | 140     |
| Welsh.. . . . .           |         | 1        |           | 1       |                |          |           |         |                           | 1        |           | 1       |
| Scotch.. . . . .          | 12      | 3        | 4         | 19      | 2              |          |           | 2       | 14                        | 3        | 4         | 21      |
| Irish.. . . . .           | 2       | 1        |           | 3       |                |          |           |         | 2                         | 1        |           | 3       |
| West Indian.. . . . .     |         |          |           |         | 3              | 3        | 1         | 7       | 3                         | 3        | 1         | 7       |
| Japanese.. . . . .        | 7       | 1        |           | 8       |                |          |           |         | 7                         | 1        |           | 8       |
| New Zealand.. . . . .     | 1       |          | 1         | 2       |                |          |           |         | 1                         |          | 1         | 2       |
| Finnish.. . . . .         |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Spanish.. . . . .         | 1       |          |           | 1       | 1              |          |           | 1       | 2                         |          |           | 2       |
| Danish.. . . . .          |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| Swedish.. . . . .         | 1       |          |           | 1       | 3              |          |           | 3       | 4                         |          |           | 4       |
| Norwegian.. . . . .       |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| U.S.A. citizens.. . . . . | 6       | 4        |           | 10      | 45             | 39       | 6         | 90      | 51                        | 43       | 6         | 100     |
| Canadian.. . . . .        | 21      | 12       | 13        | 46      | 2              |          |           | 2       | 23                        | 12       | 13        | 48      |
| Tourist.. . . . .         | 14      | 6        |           | 20      | 1              |          |           | 1       | 15                        | 6        |           | 21      |
| Totals.. . . . .          | 157     | 81       | 29        | 267     | 74             | 47       | 7         | 128     | 231                       | 128      | 36        | 395     |

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TABLE II.

NATIONALITY and Sex of Steerage Passengers arriving at the Port of Victoria, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         | UNITED STATES. |          |           |         | CANADA AND UNITED STATES. |          |           |         |
|------------------------|---------|----------|-----------|---------|----------------|----------|-----------|---------|---------------------------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. | Males.         | Females. | Children. | Totals. | Males.                    | Females. | Children. | Totals. |
| African, South.....    |         | 1        | 1         | 2       | 1              |          | 7         | 8       | 1                         | 1        | 8         | 10      |
| Australian.....        | 4       | 4        | 6         | 14      | 55             | 53       | 16        | 124     | 59                        | 57       | 22        | 138     |
| Austrian, N.E.S.....   |         |          |           |         | 4              |          |           | 4       | 4                         |          |           | 4       |
| Bohemian.....          |         |          |           |         |                | 1        |           | 1       |                           | 1        |           | 1       |
| Belgian.....           |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| Chinese.....           | 681     | 18       | 78        | 777     | 1              |          |           | 1       | 682                       | 18       | 78        | 778     |
| Dutch.....             |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| French.....            |         |          |           |         | 4              |          |           | 4       | 4                         |          |           | 4       |
| German, N.E.S.....     |         |          |           |         | 21             | 6        |           | 27      | 21                        | 6        |           | 27      |
| Saxon.....             |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| English.....           | 31      | 6        | 3         | 40      | 45             | 24       |           | 69      | 76                        | 30       | 3         | 109     |
| Welsh.....             |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| Scotch.....            | 5       | 1        |           | 6       | 13             | 5        |           | 18      | 18                        | 6        |           | 24      |
| Irish.....             | 1       |          |           | 1       | 10             | 4        |           | 14      | 11                        | 4        |           | 15      |
| West Indian.....       |         | 1        |           | 1       | 1              | 2        | 3         | 6       | 1                         | 3        | 3         | 7       |
| Greek.....             |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| Italian.....           | 1       |          |           | 1       | 6              | 2        | 1         | 9       | 7                         | 2        | 1         | 10      |
| Japanese.....          | 277     | 147      | 29        | 453     |                |          |           |         | 277                       | 147      | 29        | 453     |
| New Zealand.....       | 2       | 2        | 1         | 5       | 24             | 6        | 2         | 32      | 26                        | 8        | 3         | 37      |
| Portuguese.....        |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Polish.....            |         |          |           |         | 2              |          |           | 2       | 2                         |          |           | 2       |
| Roumanian.....         |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| Russian.....           |         |          |           |         | 2              | 2        |           | 4       | 2                         | 2        |           | 4       |
| Spanish.....           |         |          |           |         | 2              | 1        |           | 3       | 2                         | 1        |           | 3       |
| Swiss.....             |         | 1        |           | 1       | 1              |          |           | 1       | 1                         | 1        |           | 2       |
| Danish.....            |         |          |           |         | 7              | 1        |           | 8       | 7                         | 1        |           | 8       |
| Swedish.....           |         |          |           |         | 6              | 2        |           | 8       | 6                         | 2        |           | 8       |
| Norwegian.....         |         |          |           |         | 3              | 1        |           | 4       | 3                         | 1        |           | 4       |
| Turkish.....           |         |          |           |         | 1              |          |           | 1       | 1                         |          |           | 1       |
| U.S.A. citizens.....   | 1       |          |           | 1       | 94             | 36       | 38        | 168     | 95                        | 36       | 38        | 169     |
| Total immigration..... | 1,003   | 181      | 118       | 1,302   | 313            | 146      | 67        | 526     | 1,316                     | 327      | 185       | 1,828   |
| Returned Canadian..... | 1,921   | 19       | 13        | 1,953   |                |          |           |         | 1,921                     | 19       | 13        | 1,953   |
| Tourist.....           | 25      | 5        |           | 30      | 24             | 18       | 12        | 54      | 49                        | 23       | 12        | 84      |
| Totals.....            | 2,949   | 205      | 131       | 3,285   | 357            | 164      | 79        | 580     | 3,286                     | 369      | 210       | 3,865   |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, at the Port of Victoria, for the Fiscal Year ending March 31, 1909.

|                        | April. | May. | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|------------------------|--------|------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| African, South.....    |        |      |       |       |         |            |          |           |           |          | 2         |        | 2       |
| Australian.....        |        | 1    | 2     | 4     |         | 4          |          | 3         |           |          |           |        | 14      |
| Chinese.....           | 100    | 119  | 152   | 124   | 103     | 19         | 37       | 48        | 31        | 21       | 1         | 25     | 777     |
| English.....           | 1      | 2    | 17    | 2     |         | 5          |          | 2         | 1         | 1        | 2         | 6      | 40      |
| Scotch.....            | 1      | 1    | 1     |       |         | 1          |          |           |           | 1        | 1         |        | 6       |
| Irish.....             |        |      |       | 1     |         |            |          |           |           |          |           |        | 1       |
| West Indian.....       |        |      | 1     |       |         |            |          |           |           |          |           |        | 1       |
| Italian.....           |        |      | 1     |       |         |            |          |           |           |          |           |        | 1       |
| Japanese.....          | 142    | 99   | 48    | 39    | 26      | 16         | 27       | 10        | 15        | 11       | 11        | 9      | 453     |
| New Zealand.....       | 1      |      | 2     |       |         | 2          |          |           |           |          |           |        | 5       |
| Swiss.....             |        |      |       |       |         |            |          |           |           | 1        |           |        | 1       |
| U. S. A. citizens..... |        |      |       |       |         | 1          |          |           |           |          |           |        | 1       |
| Totals.....            | 245    | 222  | 224   | 170   | 129     | 39         | 64       | 63        | 47        | 35       | 24        | 40     | 1,302   |



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TABLE IV.

MONTHLY arrivals of Immigrants, for Canada, by Occupation and Destination, at the Port of Victoria, for the Fiscal Year ending March 31, 1909.

|                         | April. | May.  | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|-------------------------|--------|-------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| Agriculturists.....     | 36     | 30    | 5     | 4     | 10      | 2          | 1        | 1         | 1         | 1        | .....     | .....  | 90      |
| General labourers.....  | 117    | 40    | 16    | 41    | 14      | 9          | 6        | 1         | 3         | 3        | 9         | 9      | 268     |
| Mechanics.....          | 13     | 7     | 8     | 2     | 6       | 2          | .....    | 1         | 9         | 1        | 2         | 3      | 53      |
| Clerks.....             | 46     | 110   | 138   | 89    | 57      | 3          | 37       | 43        | 24        | 19       | 5         | 15     | 586     |
| Miners.....             | .....  | ..... | 1     | ..... | .....   | .....      | .....    | 2         | .....     | .....    | .....     | 1      | 5       |
| Female servants.....    | 1      | ..... | 2     | ..... | 1       | 1          | .....    | .....     | .....     | .....    | .....     | .....  | 5       |
| Not classified.....     | 32     | 35    | 54    | 34    | 41      | 16         | 20       | 16        | 17        | 11       | 7         | 12     | 295     |
| Totals.....             | 245    | 222   | 224   | 170   | 129     | 39         | 64       | 63        | 47        | 35       | 24        | 40     | 1,302   |
| Maritime Provinces..... | .....  | ..... | ..... | ..... | .....   | .....      | .....    | .....     | .....     | .....    | .....     | .....  | .....   |
| Quebec.....             | .....  | ..... | ..... | ..... | .....   | .....      | .....    | .....     | 1         | .....    | .....     | .....  | 1       |
| Ontario.....            | .....  | ..... | ..... | ..... | .....   | .....      | 1        | .....     | .....     | .....    | .....     | .....  | 1       |
| Manitoba.....           | .....  | ..... | ..... | ..... | .....   | .....      | .....    | .....     | .....     | .....    | .....     | 1      | 1       |
| Saskatchewan.....       | .....  | ..... | ..... | ..... | .....   | .....      | .....    | .....     | .....     | .....    | .....     | .....  | .....   |
| Alberta.....            | .....  | ..... | ..... | ..... | .....   | 1          | 2        | .....     | .....     | .....    | .....     | .....  | 3       |
| British Columbia.....   | 245    | 222   | 224   | 170   | 129     | 38         | 61       | 63        | 46        | 35       | 24        | 39     | 1,296   |
| Totals.....             | 245    | 222   | 224   | 170   | 129     | 39         | 64       | 63        | 47        | 35       | 24        | 40     | 1,302   |

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TABLE  
NATIONALITY, Sex, Occupation and Destination of Immigrant Arrivals for

|                          | SEX.   |          |           |         | TRADE OR                               |          |           |                       |          |           |            |          |           |
|--------------------------|--------|----------|-----------|---------|--|----------|-----------|-----------------------|----------|-----------|------------|----------|-----------|
|                          |        |          |           |         | Farmers or<br>Farm Labourers<br>Class. |          |           | General<br>Labourers. |          |           | Mechanics. |          |           |
|                          | Males. | Females. | Children. | Totals. | Males.                                 | Females. | Children. | Males.                | Females. | Children. | Males.     | Females. | Children. |
| African, South. . . . .  |        | 1        | 1         | 2       |  |          |           |                       |          |           |            |          |           |
| Australian . . . . .     | 4      | 4        | 6         | 14      |  |          |           |                       |          |           | 2          | 1        | 2         |
| Chinese . . . . .        | 681    | 18       | 78        | 777     | 23                                     |          | 1         | 113                   |          | 2         | 12         |          | 3         |
| English . . . . .        | 31     | 6        | 3         | 40      | 1                                      | 1        | 2         | 1                     |          |           | 11         | 1        |           |
| Scotch . . . . .         | 5      | 1        |           | 6       |  |          |           | 2                     |          |           | 1          |          |           |
| Irish . . . . .          | 1      |          |           | 1       |  |          |           |                       |          |           |            |          |           |
| West Indian . . . . .    |        | 1        |           | 1       |  |          |           |                       |          |           |            |          |           |
| Italian . . . . .        | 1      |          |           | 1       |  |          |           |                       |          |           |            |          |           |
| Japanese . . . . .       | 277    | 147      | 29        | 453     | 55                                     | 6        | 1         | 123                   | 21       | 6         | 16         | 2        |           |
| New Zealand . . . . .    | 2      | 2        | 1         | 5       |  |          |           |                       |          |           | 1          |          |           |
| Swiss . . . . .          |        | 1        |           | 1       |  |          |           |                       |          |           |            | 1        |           |
| U.S.A. citizens. . . . . | 1      |          |           | 1       |  |          |           |                       |          |           |            |          |           |
| Totals . . . . .         | 1,003  | 181      | 118       | 1,302   | 79                                     | 7        | 4         | 239                   | 21       | 8         | 43         | 5        | 5         |

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V.

Canada at the Port of Victoria, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.          |          |           |         |          |           |                  |                 |          |           | DESTINATION.        |         |          |           |               |          |                   |
|----------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|-----------|---------------------|---------|----------|-----------|---------------|----------|-------------------|
| Clerks, Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |           | Maritime Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. |
| Males.               | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children. |                     |         |          |           |               |          |                   |
| 47                   | 4        | 25        | 2       |          |           |                  | 1               | 1        |           |                     |         |          |           |               | 2        |                   |
| 2                    | 2        | 1         | 3       |          |           |                  | 55              | 14       | 47        |                     |         |          |           |               | 14       |                   |
|                      |          |           |         |          |           |                  | 7               | 1        |           |                     |         | 1        |           |               | 777      |                   |
|                      |          |           |         |          |           |                  | 2               |          |           |                     |         |          |           | 1             | 39       |                   |
|                      |          |           |         |          |           |                  | 1               |          |           |                     |         |          |           |               | 5        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         |          |           |               | 1        |                   |
| 1                    |          |           |         |          |           |                  |                 |          |           |                     |         |          |           |               | 1        |                   |
| 56                   | 10       |           |         |          |           |                  | 3               | 27       | 105       | 22                  | 1       | 1        |           |               | 449      |                   |
|                      |          |           |         |          |           |                  | 1               | 1        | 1         | 1                   |         |          |           | 2             | 5        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         |          |           |               | 1        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         |          |           |               | 1        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         |          |           |               | 1        |                   |
| 544                  | 16       | 26        | 5       |          |           | 5                | 93              | 127      | 75        | 1                   | 1       | 1        | ...       | 3             | 1,296    |                   |

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## UNITED STATES PORTS.

For the fiscal year 1908-9, there arrived in Canada, via ports in the United States, 11,267 passengers, of whom 167 travelled saloon and 11,100 steerage. Included in the steerage passengers were 270 returned Canadians and 13 tourists, leaving the immigration proper at 10,817 souls, a decrease as compared with the preceding fiscal year of 18,491 persons.

Table I. deals with the total arrivals of saloon passengers, Table II. with the total arrivals of steerage passengers, Table III. with the monthly arrivals of immigrants, and Tables IV. and V. give summaries of the information obtained from immigrants upon arrival.

TABLE I.

NATIONALITY and Sex of Saloon Passengers for Canada, via Ports in the United States, for the Fiscal Year ending March 31, 1909.

|                     | CANADA. |          |           |         |
|---------------------|---------|----------|-----------|---------|
|                     | Males.  | Females. | Children. | Totals. |
| African, South..... |         | 1        |           | 1       |
| French.....         |         | 1        |           | 1       |
| English.....        | 16      | 13       | 3         | 32      |
| Scotch.....         | 4       | 3        |           | 7       |
| Irish.....          |         | 1        |           | 1       |
| West Indian.....    | 6       | 5        | 3         | 14      |
| Jamaican.....       | 3       |          |           | 3       |
| Italian.....        | 2       |          |           | 2       |
| Negro.....          | 1       |          |           | 1       |
| Canadian.....       | 41      | 58       | 6         | 105     |
| Totals.....         | 73      | 82       | 12        | 167     |

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TABLE II.

NATIONALITY and Sex of Steerage Passengers for Canada, via Ports in the United States, for the Fiscal Year ending March 31, 1909.

|                        | CANADA. |          |           |         |
|------------------------|---------|----------|-----------|---------|
|                        | Males.  | Females. | Children. | Totals. |
| African, South.....    | 4       | 2        | 2         | 8       |
| Australian.....        | 2       | 1        |           | 3       |
| Austrian, N.E.S.....   | 907     | 205      | 165       | 1,277   |
| Bohemian.....          | 3       | 1        |           | 4       |
| Dalmatian.....         |         | 1        |           | 1       |
| Hungarian, N.E.S.....  | 314     | 69       | 47        | 430     |
| Magyar.....            |         | 1        | 3         | 4       |
| Ruthenian.....         | 116     | 4        | 2         | 122     |
| Belgian.....           | 47      | 30       | 20        | 97      |
| Bulgarian.....         | 7       | 1        |           | 8       |
| Brazilian.....         |         |          | 4         | 4       |
| Dutch.....             | 44      | 31       | 27        | 102     |
| French.....            | 141     | 62       | 8         | 211     |
| German, N.E.S.....     | 158     | 104      | 106       | 368     |
| Prussian.....          | 1       |          |           | 1       |
| English.....           | 876     | 506      | 507       | 1,889   |
| Welsh.....             | 17      | 4        | 3         | 24      |
| Scotch.....            | 184     | 138      | 32        | 354     |
| Irish.....             | 129     | 117      | 23        | 269     |
| West Indian.....       | 12      | 8        | 1         | 21      |
| Bermudian.....         | 1       | 3        |           | 4       |
| Jamaican.....          | 15      | 8        |           | 23      |
| Greek.....             | 92      | 8        | 6         | 106     |
| Hebrew, N.E.S.....     | 5       | 9        | 12        | 26      |
| " Russian.....         | 32      | 33       | 36        | 101     |
| " Austrian.....        | 2       | 1        | 2         | 5       |
| Italian.....           | 3,046   | 359      | 251       | 3,656   |
| Newfoundland.....      |         |          | 1         | 1       |
| New Zealand.....       | 1       |          |           | 1       |
| Portuguese.....        | 1       |          |           | 1       |
| Polish, N.E.S.....     | 2       | 1        | 2         | 5       |
| " Austrian.....        | 32      |          |           | 32      |
| " Russian.....         | 2       | 4        | 8         | 14      |
| Roumanian.....         | 43      | 19       | 14        | 76      |
| Russian, N.E.S.....    | 385     | 250      | 291       | 926     |
| Finnish.....           | 29      | 5        | 4         | 38      |
| Spanish.....           | 9       | 1        | 5         | 15      |
| Swiss.....             | 15      | 7        | 1         | 23      |
| Danish.....            | 22      | 14       | 4         | 40      |
| Swedish.....           | 77      | 37       | 17        | 131     |
| Norwegian.....         | 72      | 24       | 21        | 117     |
| Turkish.....           | 197     | 20       | 13        | 230     |
| Armenian.....          | 7       |          |           | 7       |
| Egyptian.....          | 1       |          |           | 1       |
| Syrian.....            | 22      | 10       | 6         | 38      |
| Arabian.....           |         | 1        |           | 1       |
| U.S.A. citizens.....   | 1       | 1        |           | 2       |
| Total immigration..... | 7,073   | 2,100    | 1,644     | 10,817  |
| Returned Canadian..... | 199     | 53       | 18        | 270     |
| Tourist.....           | 8       | 5        |           | 13      |
| Totals.....            | 7,280   | 2,158    | 1,662     | 11,100  |

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TABLE III.

MONTHLY arrivals of Immigrants for Canada, by Nationalities, via Ports in the United States, for the Fiscal Year ending March 31, 1909.

|                   | April. | May.  | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals. |
|-------------------|--------|-------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|---------|
| African, South... |        | 1     |       | 1     | 1       | 2          |          |           |           | 2        | 1         |        | 8       |
| Australian        |        |       |       |       |         |            | 1        | 2         |           |          |           |        | 3       |
| Austrian, N.E.S.  | 451    | 173   | 107   | 48    | 39      | 39         | 87       | 85        | 52        | 39       | 45        | 112    | 1,277   |
| Bohemian          |        | 2     |       |       |         |            |          | 1         |           |          |           |        | 4       |
| Dalmatian         |        | 1     |       |       |         |            |          |           |           |          |           |        | 1       |
| Hungarian, N.E.S. | 67     | 31    | 28    | 16    | 11      | 22         | 29       | 22        | 28        | 37       | 52        | 87     | 430     |
| Magyar            | 4      |       |       |       |         |            |          |           |           |          |           |        | 4       |
| Ruthenian         | 122    |       |       |       |         |            |          |           |           |          |           |        | 122     |
| Belgian           | 34     | 13    | 8     |       | 7       | 5          | 4        | 2         | 7         | 2        | 7         |        | 97      |
| Bulgarian         |        |       | 1     |       | 1       |            |          | 2         | 1         |          |           |        | 8       |
| Brazilian         |        |       |       |       |         |            |          |           |           |          |           |        | 4       |
| Dutch             | 30     | 1     | 9     | 1     | 5       | 8          | 3        | 5         | 8         | 4        | 2         |        | 102     |
| French            | 45     | 24    | 18    | 16    | 15      | 22         | 12       | 9         | 4         | 14       | 9         |        | 211     |
| German, N.E.S.    | 91     | 30    | 25    | 35    | 31      | 21         | 21       | 16        | 12        | 22       | 7         | 57     | 368     |
| Prussian          |        | 1     |       |       |         |            |          |           |           |          |           |        | 1       |
| English           | 788    | 115   | 72    | 52    | 59      | 33         | 63       | 39        | 61        | 85       | 76        | 446    | 1,889   |
| Welsh             | 11     | 4     | 1     |       |         | 1          | 1        |           | 2         | 1        | 1         |        | 24      |
| Scotch            | 73     | 20    | 17    | 23    | 8       | 8          | 10       | 5         | 31        | 29       | 33        |        | 354     |
| Irish             | 80     | 32    | 15    | 11    | 12      | 18         | 18       | 3         | 21        | 10       | 13        | 36     | 269     |
| West Indian       |        | 7     | 1     | 4     | 1       | 5          |          | 1         |           |          |           |        | 21      |
| Bernudian         |        |       |       |       | 1       |            |          |           |           |          | 1         |        | 4       |
| Jamaican          | 3      | 1     | 8     |       |         | 3          | 6        |           |           |          |           |        | 23      |
| Greek             | 24     | 12    | 4     | 7     | 13      | 3          | 1        | 2         | 15        | 1        |           | 24     | 106     |
| Hebrew, N.E.S.    | 8      | 1     |       |       |         |            |          |           | 2         | 15       |           |        | 26      |
| " Russian         | 36     |       |       |       |         |            | 1        |           | 18        |          | 28        | 18     | 101     |
| " Austrian        | 5      |       |       |       |         |            |          |           |           |          |           |        | 5       |
| Italian           | 1,035  | 852   | 172   | 67    | 86      | 95         | 116      | 104       | 116       | 66       | 241       | 706    | 3,656   |
| Newfoundland      |        | 1     |       |       |         |            |          |           |           |          |           |        | 1       |
| New Zealand       |        |       |       | 1     |         |            |          |           |           |          |           |        | 1       |
| Portuguese        | 1      |       |       |       |         |            |          |           |           |          |           |        | 1       |
| Polish, N.E.S.    |        |       |       |       |         |            |          |           |           |          |           | 5      | 5       |
| " Austrian        | 32     |       |       |       |         |            |          |           |           |          |           |        | 32      |
| " Russian         |        |       |       |       |         |            |          |           |           |          |           | 14     | 14      |
| Roumanian         | 3      | 17    | 9     |       |         | 10         | 4        | 3         | 20        |          | 5         |        | 76      |
| Russian, N.E.S.   | 127    | 91    | 33    | 80    | 55      | 94         | 57       | 113       | 89        | 51       | 37        | 99     | 926     |
| Finnish           | 2      |       | 3     |       |         |            | 3        | 2         | 1         |          | 16        | 11     | 38      |
| Spanish           | 5      |       |       | 1     |         | 2          | 7        |           |           |          |           |        | 15      |
| Swiss             | 3      | 4     | 4     | 3     |         | 2          | 4        |           | 2         |          |           |        | 23      |
| Danish            | 5      | 7     | 8     | 3     | 6       | 1          | 1        |           | 1         | 1        | 4         |        | 40      |
| Swedish           | 15     | 30    | 4     | 2     | 9       | 5          | 27       | 9         | 5         | 4        | 10        | 11     | 131     |
| Norwegian         | 30     | 8     | 9     | 7     |         | 12         | 7        | 3         | 3         | 15       | 5         | 18     | 117     |
| Turkish           | 4      | 36    | 5     | 5     | 1       | 9          | 30       | 17        | 11        | 13       | 27        | 72     | 230     |
| Armenian          | 4      |       |       |       |         |            |          | 1         |           |          | 1         |        | 7       |
| Egyptian          |        |       |       |       | 1       |            |          |           |           |          |           |        | 1       |
| Syrian            | 1      |       | 7     |       | 4       | 7          | 13       |           | 1         | 5        |           |        | 38      |
| Arabian           |        |       |       |       |         |            |          | 1         |           |          |           |        | 1       |
| U. S. A. citizens | 1      |       |       |       |         |            |          |           |           |          |           | 1      | 2       |
| Totals            | 3,140  | 1,515 | 563   | 383   | 366     | 427        | 526      | 447       | 511       | 418      | 621       | 1,900  | 10,817  |

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TABLE IV.

MONTHLY arrivals of Immigrants for Canada, by Occupation and Destination, via Ports in the United States, for the Fiscal Year ending March 31, 1909.

|                         | April.       | May.         | June.      | July.      | August.    | September. | October.   | November.  | December.  | January.   | February.  | March.       | Totals.       |
|-------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|---------------|
| Agriculturists.....     | 1,019        | 544          | 134        | 90         | 107        | 111        | 160        | 119        | 135        | 113        | 202        | 652          | 3,386         |
| General labourers.....  | 1,098        | 493          | 151        | 66         | 41         | 71         | 73         | 107        | 112        | 78         | 217        | 917          | 3,424         |
| Mechanics.....          | 449          | 131          | 52         | 50         | 32         | 33         | 45         | 25         | 57         | 42         | 61         | 114          | 1,091         |
| Clerks.....             | 121          | 60           | 63         | 56         | 45         | 22         | 48         | 25         | 31         | 49         | 43         | 60           | 626           |
| Miners.....             | 30           | 9            | 9          | 2          | 5          | 1          | 7          | 2          | 7          | 14         | 24         | 22           | 132           |
| Female servants.....    | 152          | 50           | 26         | 28         | 25         | 33         | 38         | 34         | 58         | 49         | 38         | 71           | 602           |
| Not classified.....     | 268          | 228          | 128        | 91         | 111        | 156        | 155        | 135        | 111        | 73         | 36         | 64           | 1,556         |
| <b>Totals.....</b>      | <b>3,140</b> | <b>1,515</b> | <b>563</b> | <b>383</b> | <b>366</b> | <b>427</b> | <b>526</b> | <b>447</b> | <b>511</b> | <b>418</b> | <b>621</b> | <b>1,900</b> | <b>10,817</b> |
| Maritime Provinces..... | 19           | 23           | 21         | 18         | 16         | 10         | 14         | 18         | 18         | 10         | 24         | 10           | 201           |
| Quebec.....             | 1,041        | 497          | 147        | 69         | 82         | 87         | 112        | 77         | 148        | 92         | 185        | 469          | 3,006         |
| Ontario.....            | 1,284        | 634          | 209        | 116        | 124        | 164        | 163        | 151        | 158        | 142        | 232        | 918          | 4,295         |
| Manitoba.....           | 352          | 149          | 75         | 54         | 35         | 38         | 59         | 70         | 58         | 54         | 41         | 136          | 1,121         |
| Saskatchewan.....       | 131          | 39           | 28         | 48         | 43         | 54         | 59         | 58         | 41         | 26         | 16         | 79           | 625           |
| Alberta.....            | 114          | 56           | 27         | 26         | 35         | 24         | 59         | 24         | 22         | 21         | 37         | 120          | 566           |
| British Columbia.....   | 199          | 117          | 56         | 52         | 31         | 50         | 60         | 49         | 63         | 72         | 86         | 168          | 1,003         |
| <b>Totals.....</b>      | <b>3,140</b> | <b>1,515</b> | <b>563</b> | <b>383</b> | <b>366</b> | <b>427</b> | <b>526</b> | <b>447</b> | <b>511</b> | <b>418</b> | <b>621</b> | <b>1,900</b> | <b>10,817</b> |

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TABLE  
 NATIONALITY, Sex, Occupation and Destination of Immigrant arrivals for Canada,

|                     | SEX.   |          |           |         | TRADE OR                            |          |           |                   |          |           |            |          |           |
|---------------------|--------|----------|-----------|---------|-------------------------------------|----------|-----------|-------------------|----------|-----------|------------|----------|-----------|
|                     |        |          |           |         | Farmers or Farm<br>Labourers Class. |          |           | General Labourers |          |           | Mechanics. |          |           |
|                     | Males. | Females. | Children. | Totals. | Males.                              | Females. | Children. | Males.            | Females. | Children. | Males.     | Females. | Children. |
| African, South..... | 4      | 2        | 2         | 8       |                                     |          |           |                   |          | 1         | 1          |          |           |
| Australian.....     | 2      | 1        |           | 3       |                                     |          |           |                   |          |           | 1          |          |           |
| Austrian, N.E.S.... | 907    | 205      | 165       | 1,277   | 495                                 | 51       | 54        | 360               | 19       | 39        | 33         | 8        | 4         |
| Bohemian.....       | 3      | 1        |           | 4       |                                     |          |           |                   |          |           |            |          |           |
| Dalmatian.....      |        | 1        |           | 1       |                                     | 1        |           |                   |          |           |            |          |           |
| Hungarian, N.E.S..  | 314    | 69       | 47        | 430     | 265                                 | 27       | 18        | 35                | 2        | 1         | 12         | 1        |           |
| Magyar.....         |        | 1        | 3         | 4       |                                     |          |           |                   |          |           |            |          |           |
| Ruthenian.....      | 116    | 4        | 2         | 122     | 112                                 | 2        | 2         |                   |          |           | 4          |          |           |
| Belgian.....        | 47     | 30       | 20        | 97      | 17                                  | 2        | 2         | 7                 | 4        | 1         | 7          | 5        | 4         |
| Bulgarian.....      | 7      | 1        |           | 8       | 1                                   |          |           | 5                 |          |           | 1          |          |           |
| Brazilian.....      |        |          | 4         | 4       |                                     |          |           |                   |          |           |            |          |           |
| Dutch.....          | 44     | 31       | 27        | 102     | 25                                  | 6        | 15        | 2                 | 1        |           | 7          | 3        | 2         |
| French.....         | 141    | 62       | 8         | 211     | 97                                  | 7        |           | 19                | 3        | 1         | 25         | 4        | 1         |
| German, N.E.S....   | 158    | 104      | 106       | 368     | 53                                  | 19       | 38        | 18                | 10       | 8         | 37         | 12       | 10        |
| Prussian.....       | 1      |          |           | 1       | 1                                   |          |           |                   |          |           |            |          |           |
| English.....        | 876    | 506      | 507       | 1,889   | 168                                 | 34       | 46        | 174               | 60       | 273       | 238        | 90       | 102       |
| Welsh.....          | 17     | 4        | 3         | 24      | 4                                   | 1        | 3         | 3                 |          |           | 5          | 1        |           |
| Scottish.....       | 184    | 138      | 32        | 354     | 30                                  | 3        |           | 21                | 3        | 3         | 42         | 15       | 3         |
| Irish.....          | 129    | 117      | 23        | 269     | 11                                  | 4        | 1         | 28                | 8        | 12        | 21         | 3        |           |
| West Indian.....    | 12     | 8        | 1         | 21      | 1                                   |          |           | 1                 | 1        | 1         | 2          |          |           |
| Bermudian.....      | 1      | 3        |           | 4       |                                     |          |           |                   |          |           |            |          |           |
| Jamaican.....       | 15     | 8        |           | 23      |                                     |          |           |                   |          |           | 2          |          |           |
| Greek.....          | 92     | 8        | 6         | 106     | 17                                  |          |           | 68                | 4        | 3         | 4          | 1        | 1         |
| Hebrew, N.E.S....   | 5      | 9        | 12        | 26      |                                     |          |           | 1                 |          | 3         | 3          | 5        | 8         |
| "    Russian....    | 32     | 33       | 36        | 101     | 1                                   | 1        | 4         | 12                | 3        | 9         | 17         | 15       | 7         |
| "    Austrian....   | 2      | 1        | 2         | 5       |                                     |          |           |                   |          |           |            |          |           |
| Italian.....        | 3,046  | 359      | 251       | 3,656   | 1,155                               | 43       | 36        | 1,639             | 50       | 43        | 156        | 12       | 7         |
| Newfoundland....    |        |          | 1         | 1       |                                     |          |           |                   |          |           |            |          |           |
| New Zealand.....    | 1      |          |           | 1       |                                     |          |           |                   |          |           |            |          |           |
| Portuguese.....     | 1      |          |           | 1       |                                     |          |           |                   |          |           |            |          |           |
| Polish, N.E.S....   | 2      | 1        | 2         | 5       |                                     |          |           | 2                 | 1        | 2         |            |          |           |
| "    Austrian....   | 32     |          |           | 32      | 25                                  |          |           | 6                 |          |           | 1          |          |           |
| "    Russian....    | 2      | 4        | 8         | 14      | 2                                   | 4        | 8         |                   |          |           |            |          |           |
| Roumanian.....      | 43     | 19       | 14        | 76      | 8                                   | 4        | 1         | 27                | 3        | 3         | 3          | 2        | 1         |
| Russian, N.E.S....  | 385    | 250      | 291       | 926     | 208                                 | 57       | 95        | 110               | 20       | 26        | 48         | 35       | 15        |
| Finnish.....        | 29     | 5        | 4         | 38      |                                     |          |           | 23                | 4        | 3         | 1          |          |           |
| Spanish.....        | 9      | 1        | 5         | 15      |                                     |          |           | 4                 |          |           | 1          |          |           |
| Swiss.....          | 15     | 7        | 1         | 23      | 5                                   |          |           | 1                 |          |           | 2          |          |           |
| Danish.....         | 22     | 14       | 4         | 40      | 10                                  |          |           | 6                 |          |           | 3          | 1        |           |
| Swedish.....        | 77     | 37       | 17        | 131     | 14                                  | 3        | 4         | 45                | 3        |           | 11         | 4        | 1         |
| Norwegian.....      | 72     | 24       | 21        | 117     | 12                                  | 3        | 7         | 51                | 3        | 11        | 6          | 1        |           |
| Turkish.....        | 197    | 20       | 13        | 230     | 84                                  | 2        | 2         | 97                | 4        | 2         | 9          |          | 1         |
| Armenian.....       | 7      |          |           | 7       |                                     |          |           | 6                 |          |           |            |          |           |
| Egyptian.....       | 1      |          |           | 1       |                                     |          |           | 1                 |          |           |            |          |           |
| Syrian.....         | 22     | 10       | 6         | 38      | 12                                  |          | 2         | 1                 |          |           | 3          |          |           |
| Arabian.....        |        | 1        |           | 1       |                                     |          |           |                   |          |           |            |          |           |
| U. S. A. citizens.. | 1      | 1        |           | 2       |                                     |          |           |                   |          |           |            |          |           |
| Totals.....         | 7,073  | 2,100    | 1,644     | 10,817  | 2,774                               | 274      | 338       | 2,773             | 206      | 445       | 706        | 218      | 167       |



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V.  
via Ports in the United States, for the Fiscal Year ending March 31, 1909.

| OCCUPATION.          |          |           |         |          |           | DESTINATION.     |                 |          |           |                     |         |          |           |               |          |                   |
|----------------------|----------|-----------|---------|----------|-----------|------------------|-----------------|----------|-----------|---------------------|---------|----------|-----------|---------------|----------|-------------------|
| Clerks, Traders, &c. |          |           | Miners. |          |           | Female Servants. | Not Classified. |          |           | Maritime Provinces. | Quebec. | Ontario. | Manitoba. | Saskatchewan. | Alberta. | British Columbia. |
| Males.               | Females. | Children. | Males.  | Females. | Children. |                  | Males.          | Females. | Children. |                     |         |          |           |               |          |                   |
| 1                    | 1        | 1         |         |          |           | 1                | 2               |          |           | 2                   | 1       | 2        |           |               | 3        |                   |
| 1                    |          |           |         |          |           |                  |                 | 1        |           |                     |         | 2        |           |               | 1        |                   |
| 16                   | 5        | 12        |         |          |           | 63               | 3               | 59       | 66        | 21                  | 458     | 277      | 349       | 51            | 35       |                   |
|                      |          |           |         | 3        |           | 1                |                 |          |           |                     |         |          |           |               | 2        |                   |
| 1                    |          | 1         |         |          |           | 12               | 1               | 27       | 27        | 30                  | 17      | 129      | 45        | 54            | 105      |                   |
|                      |          |           |         |          |           |                  |                 | 1        | 3         |                     |         |          | 1         |               |          |                   |
| 6                    | 1        |           | 6       | 6        | 7         | 3                | 4               | 9        | 6         | 4                   | 87      | 18       | 16        |               | 1        |                   |
|                      | 1        |           |         |          |           |                  |                 |          |           |                     | 33      | 15       | 12        | 2             | 1        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     | 3       | 5        |           |               | 24       |                   |
|                      |          |           |         |          |           |                  |                 |          | 4         |                     |         |          |           |               |          |                   |
| 5                    | 2        | 1         |         |          |           | 6                | 5               | 13       | 9         |                     | 15      | 21       | 35        | 12            | 17       |                   |
| 23                   | 2        |           | 3       |          |           | 9                | 36              | 37       | 6         | 1                   | 117     | 35       | 33        | 10            | 8        |                   |
| 31                   | 8        | 9         | 4       |          |           | 22               | 15              | 33       | 41        | 3                   | 42      | 75       | 57        | 78            | 27       |                   |
| 187                  | 45       | 17        | 13      | 5        | 6         | 133              | 96              | 139      | 63        | 19                  | 265     | 1,125    | 204       | 73            | 125      |                   |
| 2                    |          |           | 1       |          |           | 1                | 2               | 1        |           |                     | 1       | 16       |           | 3             | 1        |                   |
| 61                   | 7        |           | 7       | 1        |           | 75               | 23              | 34       | 26        | 7                   | 100     | 163      | 24        | 6             | 43       |                   |
| 47                   | 6        |           | 1       | 2        |           | 72               | 21              | 22       | 10        | 8                   | 81      | 103      | 35        | 10            | 12       |                   |
| 2                    | 1        |           |         |          |           | 3                | 6               | 3        |           |                     | 5       | 16       |           |               |          |                   |
|                      |          |           |         |          |           |                  | 1               | 3        |           |                     | 1       | 3        |           |               |          |                   |
| 1                    |          |           |         |          |           |                  | 12              |          |           |                     | 5       | 18       |           |               |          |                   |
| 3                    |          |           |         |          |           | 2                |                 | 1        | 2         |                     | 42      | 50       | 1         |               | 12       |                   |
| 1                    |          |           |         |          |           | 2                |                 | 2        | 1         | 1                   | 2       | 11       | 12        |               |          |                   |
|                      | 4        | 11        |         |          |           | 3                | 2               | 7        | 5         |                     | 28      | 39       | 29        | 4             | 1        |                   |
| 2                    |          | 1         |         |          |           |                  |                 |          | 1         |                     | 5       |          |           |               |          |                   |
| 27                   | 4        | 4         | 51      | 1        | 4         | 33               | 18              | 161      | 157       | 70                  | 1,315   | 1,622    | 78        | 8             | 448      |                   |
| 1                    |          |           |         |          |           |                  |                 |          | 1         |                     | 1       |          |           |               |          |                   |
|                      |          |           |         |          |           |                  | 1               |          |           |                     |         | 1        |           |               |          |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         | 16       | 12        | 4             | 5        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     |         | 11       |           |               |          |                   |
| 3                    |          |           |         |          |           | 4                | 2               | 6        | 9         |                     | 47      | 21       | 4         | 4             | 1        |                   |
| 17                   | 6        | 5         | 1       | 1        |           | 53               | 1               | 78       | 150       | 24                  | 218     | 248      | 126       | 232           | 25       |                   |
|                      |          |           | 5       |          |           |                  |                 | 1        | 1         |                     | 1       | 29       | 1         | 4             | 2        |                   |
| 4                    | 1        | 5         |         |          |           |                  |                 |          |           |                     | 10      | 5        |           |               |          |                   |
| 3                    | 1        | 1         | 1       |          |           | 2                | 3               | 4        |           |                     | 8       | 5        | 3         |               | 2        |                   |
| 2                    |          |           |         |          |           | 9                | 1               | 4        | 4         |                     | 5       | 8        | 9         | 11            | 4        |                   |
| 5                    | 1        |           | 1       |          |           | 18               | 1               | 8        | 12        |                     | 6       | 26       | 29        | 20            | 30       |                   |
| 2                    | 2        |           |         |          |           | 8                | 1               | 7        | 3         | 5                   | 9       | 12       | 9         | 22            | 36       |                   |
| 3                    | 1        |           | 3       |          |           | 5                | 1               | 4        | 8         | 3                   | 56      | 146      |           | 1             | 24       |                   |
|                      |          |           |         |          |           |                  |                 |          |           | 1                   |         | 6        |           |               |          |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     | 1       |          |           |               |          |                   |
| 6                    | 6        | 1         |         |          |           | 1                |                 | 3        | 3         | 5                   | 11      | 16       |           |               | 6        |                   |
|                      |          |           |         |          |           |                  |                 |          |           |                     | 1       |          |           |               |          |                   |
|                      |          |           |         |          |           |                  | 1               | 1        |           |                     |         | 1        |           |               | 1        |                   |
| 462                  | 105      | 59        | 99      | 16       | 17        | 602              | 259             | 679      | 618       | 201                 | 3,006   | 4,295    | 1,121     | 625           | 1,003    |                   |

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STATEMENT showing the number of Immigrants debarred at Ocean ports since December, 1902, when the Medical Act went into force, also the number held for further inspection.

|                            | No. held for further inspection. | No. rejected. |
|----------------------------|----------------------------------|---------------|
| Fiscal year 1902-1903..... | 273                              | 273           |
| " 1903-1904.....           | 1,835                            | 274           |
| " 1904-1905.....           | 2,559                            | 611           |
| " 1905-1906.....           | 3,570                            | 524           |
| " 1906-1907.....           | 3,543                            | 440           |
| " 1907-1908.....           | 4,573                            | 1,172         |
| " 1908-1909.....           | 3,544                            | 509           |
| Totals .....               | 19,897                           | 3,803         |

Inspection of Immigrants seeking admission to Canada from the United States was begun in April, 1908, and during the fiscal year 1908-1909, 4,580 intending immigrants were debarred.

STATEMENT showing the number of Immigrants who were deported, that is, Immigrants who passed inspection and who afterwards became a public charge in one way or another, and were returned to the country from which they came, during 1902-3, 1903-4, 1904-5, 1905-6, fractional fiscal year (9 mos.) 1906-7, 1907-8 and 1908-9.

|                      |       |
|----------------------|-------|
| English.....         | 2,007 |
| Scotch.....          | 206   |
| American.....        | 149   |
| Bulgarian.....       | 137   |
| Irish.....           | 81    |
| Russian, N.E.S.....  | 56    |
| Galician.....        | 49    |
| Roumanian.....       | 44    |
| Hebrew, N.E.S.....   | 40    |
| Swedish.....         | 33    |
| Greek.....           | 32    |
| Italian.....         | 31    |
| Hindoo.....          | 29    |
| Norwegian.....       | 29    |
| French.....          | 26    |
| Dutch.....           | 22    |
| Hebrew, Russian..... | 21    |
| Turkish.....         | 20    |
| Austrian, N.E.S..... | 20    |
| Danish.....          | 17    |
| German.....          | 15    |
| Finnish.....         | 14    |
| Welsh.....           | 9     |
| Bukowinian.....      | 9     |
| Hungarian.....       | 8     |
| Icelandic.....       | 8     |
| Japanese.....        | 4     |
| Belgian.....         | 3     |
| Bohemian.....        | 3     |
| West Indian.....     | 3     |
| Polish, Russian..... | 3     |
| Polish, N.E.S.....   | 2     |

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|                       |       |
|-----------------------|-------|
| Australian.....       | 2     |
| Chinese.....          | 2     |
| Swiss.....            | 2     |
| Syrian.....           | 2     |
| Hebrew, Austrian..... | 2     |
| South African.....    | 1     |
| Denkhobor.....        | 1     |
| Hebrew, German.....   | 1     |
| Hebrew, Polish.....   | 1     |
| Newfoundland.....     | 1     |
| Negro.....            | 1     |
| Jamaican.....         | 1     |
| Ruthenian.....        | 1     |
| Spanish.....          | 1     |
| Total.....            | 3,149 |

## STATEMENT showing the number of Immigrants deported since December, 1902, by Years.

|                          |       |
|--------------------------|-------|
| Fiscal year 1902-03..... | 67    |
| “ 1903-04.....           | 85    |
| “ 1904-05.....           | 86    |
| “ 1905-06.....           | 137   |
| “ 1906-07.....           | 201   |
| “ 1907-08.....           | 825   |
| “ 1908-09.....           | 1,748 |
| Total.....               | 3,149 |

The following is a statement showing Immigration literature, &c., ordered during the year :—

|   | Copies. |
|---|---------|
| L'Alberta Nord.....                                   | 20,000  |
| Land Regulations in Canada.....                       | 100,000 |
| Nova Scotia pamphlet.....                             | 35,000  |
| Eastern Townships of Quebec.....                      | 20,000  |
| Mercantile and Financial Times.....                   | 500     |
| Canadian Courier.....                                 | 25,000  |
| Immigration Act (English).....                        | 10,000  |
| Immigration Act (French).....                         | 5,000   |
| Calendar 'Welcome Stranger'.....                      | 50,000  |
| Canada West Magazine.....                             | 10,000  |
| British Columbia pamphlet.....                        | 20,000  |
| Danish pamphlets.....                                 | 1,500   |
| Opportunities in Canada.....                          | 20,000  |
| Prince Edward Island pamphlet.....                    | 10,000  |
| Post Cards (French).....                              | 100,000 |
| La Colombie Britannique.....                          | 200     |
| Grand Trunk Pacific folder Map.....                   | 60,000  |
| A trip through Canada by Scottish Agriculturists..... | 200     |
| Homestead Regulation Sheets.....                      | 70,000  |
| Canada the Land of Opportunity.....                   | 110,000 |
| Agriculture tour through Canada.....                  | 100,000 |

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|   |         |
|---|---------|
| Classes wanted in Canada.....                         | 100,000 |
| Alberta Red winter wheat.....                         | 100,000 |
| East Indians in British Columbia.....                 | 2,000   |
| Canada as it appeared to Scottish Agriculturists..... | 100,000 |
| New Brunswick pamphlet.....                           | 10,000  |
| Thunder Bay and Rainy River District.....             | 5,000   |
| Prosperity follows Settlement.....                    | 100,000 |
| Canadian Life and Resources.....                      | 6,000   |
| Atlas of Canada (English).....                        | 178,000 |
| Atlas of Canada (Bound, English).....                 | 6,000   |
| "    "    (French).....                               | 55,000  |
| "    "    (Bound).....                                | 3,000   |
| "    "    (Flemish).....                              | 10,000  |
| "    "    (Dutch).....                                | 10,000  |
| 'Last Best West' (English).....                       | 252,500 |
| "    (French).....                                    | 25,000  |

## MAPS.

|                                   |        |
|-----------------------------------|--------|
| School maps (English).....        | 5,000  |
| "    (French).....                | 5,000  |
| Pre-Emption maps.....             | 88,000 |
| Small Dominion of Canada map..... | 6,000  |
| New Scotia map.....               | 10,000 |
| New Brunswick map.....            | 10,000 |
| Prince Edward Island.....         | 10,000 |
| British Columbia.....             | 10,000 |

## NEWSPAPERS.

|   |        |
|---|--------|
| Saskatoon <i>Phoenix</i> .....          | 13,500 |
| Vermilion <i>Signal</i> .....           | 3,000  |
| <i>The Canada Posten</i> (Swedish)..... | 5,000  |
| <i>Canadian Hungarian</i> .....         | 15,000 |
| <i>Der Nordvesten</i> .....             | 26,000 |
| "    Special Edition.....               | 50,000 |
| <i>Christmas Globe</i> .....            | 200    |
| Saskatchewan <i>Courier</i> .....       | 15,580 |
| "    "    Special.....                  | 5,000  |
| Vegreville <i>Observer</i> .....        | 2,500  |
| <i>Canada Scotsman</i> .....            | 5,000  |
| Alberta <i>Herold</i> (German).....     | 26,000 |
| <i>Canada</i> (Swedish weekly).....     | 24,000 |
| <i>Danebrog</i> .....                   | 12,000 |
| <i>Logberg</i> (Icelandic).....         | 26,000 |
| <i>Le Nouvelliste</i> .....             | 1,000  |
| Lethbridge <i>Herald</i> .....          | 1,000  |

One hundred and eighty-six thousand two hundred and seventy-nine pieces of mail were received and attended to in my office during the fiscal year, an increase of 23,164 upon the figure for the previous fiscal year; 315,006 requests for information, direct and indirect, were received and attended to.

Your obedient servant,

W. D. SCOTT,  
*Superintendent of Immigration.*

# OPERATIONS IN EUROPE.

## No. 1.

REPORT OF J. OBED SMITH.

11 AND 12 CHARING CROSS,

LONDON, S.W., April 2, 1909.

The Right Honourable

LORD STRATUCONA AND MOUNT ROYAL, G.C.M.G.,

High Commissioner for Canada,

17 Victoria Street, S.W.

MY LORD,—I have the honour to submit the report of the Emigration Branch of the Department of the Interior, covering the agencies in the United Kingdom and the agency at Antwerp, in Belgium, for the fiscal year ending March 31, 1909, together with the individual reports of the various emigration agents for the same period.

As the result of personal inspections of the various agency premises during the past year, I am able to state with confidence that they are suitably situated, easily accessible to the public, and generally well adapted for the purposes of this branch of the department. I would, however, recommend that, on the expiry of the present lease of the Liverpool agency office, steps be taken to secure premises on the street level of a public thoroughfare, with ample window space for the display of exhibits, &c., which principle has been adopted in all the other agencies with marked success.

A striking feature in connection with the emigration propaganda during the past year has been the constantly changing displays of products and exhibits in the various agencies of the department, at large and small agricultural shows and fairs, at many small county exhibitions; and, as far as the stock would permit, miniature displays in the offices of a large number of booking agents throughout the country. This feature in my opinion is one capable of considerable extension with profitable results to the Dominion, and although the supply of suitable display material in the past has been large, I would respectfully recommend that it be largely increased in the future. In this connection I venture to believe that Canada has now reached a position in the knowledge of British people and others that her capacity to grow the finest wheat is established and admitted to be a fact, and while this prime object of our emigration work must ever be kept to the front, there are other branches of agriculture and kindred industries from which substantial, attractive and suitable exhibits could be made with great advantage.

The adopted programme of advertising in the country and provincial papers, in preference to the large and expensive city journals, has been continued and extended during the past year. Our agents are constantly on the watch for a newspaper that reaches the class of emigrants most sought after by Canada, and it is gratifying to note that practically without exception the provincial press in the British isles is now favourably disposed towards Canada. Perhaps some exception might be made to this statement in some parts of Ireland, where there is a strong feeling against any attempt to emigrate people from those districts, but in all other parts of the British isles Canada has so established her reputation, that the next step of developing emigration and trade, as a result of that knowledge, becomes natural and easy.

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During the past twelve months our exhibition motor cars have travelled from the south of England to the north of Scotland, calling at hundreds of small country villages and school-houses, and distributing literature and information at all points. In addition, the exhibition horse-wagons have covered very effectually several large districts that are more or less inaccessible or inconvenient for motor cars. I cannot too strongly recommend the continuance and extension of this desirable missionary work.

On April 15, 1908, there became effective an order in council, approved by His Excellency the Governor General on February 25, 1908, as follows:—

‘On a memorandum, dated February 20, 1908, from the Minister of the Interior, stating that a very considerable number of emigrants arriving in Canada from the British isles have either been rejected at Canadian ports or afterwards deported from Canada as undesirables, for causes named in the Immigration Act ;

‘That during the year 1907 there were some 141 rejections and 441 deportations of British emigrants ;

‘That among the many charitable and philanthropic associations actively engaged in the British isles in sending and financially assisting immigrants to Canada are some whose work is chiefly among the unemployed, destitute and incompetent classes in the congested centres of population.

‘While the minister does not contend that some of these immigrants may not make successful citizens of Canada, nevertheless it is true that it is not the object of these associations to encourage the immigration of the really competent, industrious and ambitious man so long as he succeeds in supporting himself, and that their operations are confined almost exclusively to the class from which it is very unlikely that the needs of Canada can be properly supplied.

‘The class referred to includes not only the unemployed but a large proportion of those who are a drag in the labour market from misfortune, incompetence or indifference. In the case of these it is no alleviation of their condition to transfer them here, because our experience is that they simply continue in the same condition, and are a detriment to Canada.

‘While the associations engaged in this work often claim, and perhaps endeavour to use discrimination in the matter of selection, in effect it is found that emigrants are sent here who are entirely unsuited to the conditions prevailing in this country, and who are unlikely to succeed even under the most favourable circumstances.

‘The work of these associations does not come under the supervision of the Canadian Immigration Department in the British isles, and it is very advisable that more effective measures should be adopted, supervisory and restrictive, in regard to the undesirable classes.

‘It might be mentioned that the Department of the Interior exercises a degree of supervision over a certain very limited class of immigrants, who are sent out by the Poor Law Guardians. If the guardians of a district are satisfied that a person, who has been a charge on them, is really capable of working his way in Canada, or elsewhere, under new conditions, and with a fair start, they secure an appropriation from public moneys for the purpose of the emigration of such person. When an emigrant is sent out in this way, it is imperative that the consent of the assistant superintendent of emigration for Canada be obtained. In this way the department exercises some control. Independent inquiry is made, a medical certificate is obtained, and other precautions taken to make sure of the suitability of the emigrant.

‘The minister is of the opinion that a similar system of inspection should be extended to all charitable and philanthropic societies or organizations operating in England, whether using public money or funds provided by public generosity so that persons whom they propose sending to Canada may be subject to inspection by the officer representing the Canadian Government Emigration Department in London, as to their antecedents, both morally and physically, and as to their general suitability

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for settlement in Canada; such persons to be allowed entry into Canada only upon presentation of a proper certificate from the assistant superintendent of emigration; and to be subject to exclusion and deportation in the usual way, should they succeed in gaining admittance to Canada in contravention of the regulations.

'The Immigration Act (Sec. 10) provides that—

- "The Governor in Council may on the recommendation of the minister, make such orders and regulations, not inconsistent with this Act, as are considered necessary or expedient for the carrying out of this Act according to its true intent and meaning and for the better attainment of its objects."

'The minister, therefore, recommends that an order in council be passed prohibiting, from and after the fifteenth day of April, 1908, the landing in Canada of any person whose passage has been paid, wholly or in part, by any charitable organization or out of public moneys, unless it is shown that the authority in writing of the assistant superintendent of emigration for Canada in London, has been obtained for the emigration of such person, and that such authority has been acted upon within a period of sixty days.

'The committee submit the same for approval.

'RODOLPHE BOUDREAU,  
'Clerk of the Privy Council.

'The Honourable  
'The Minister of the Interior.'

This was followed by a general circular from the department on May 12, 1908, as follows:—

'IMMIGRATION BRANCH,  
'DEPARTMENT OF THE INTERIOR,  
'OTTAWA, CANADA, May 12, 1908.

'Notice is hereby given that the only classes of immigrants wanted in Canada at the present time are experienced farm labourers, farmers financially able to take homesteads or purchase lands, and female domestic servants.

'The demand for railway labour is filled for this season.

'All concerned are requested to note the above carefully, and also to note that the regulation now in operation in Canada requiring every immigrant 18 years of age or over, to have in his possession at least \$25 cash at time of landing, besides ticket to destination, will be enforced strictly and impartially in the case of all immigrants outside of the classes above mentioned.

'W. D. SCOTT,  
'Superintendent of Immigration.'

- An order in council approved by His Excellency the Governor General on September 11, 1908, became operative and is as follows:—

'PRIVY COUNCIL, CANADA,  
'At the Government House at Ottawa,  
'FRIDAY, the 11th day of September, 1908.

'Present,

'His Excellency the Governor General in Council.

'His Excellency the Governor General in Council, in virtue of the provisions of section 20 of the Immigration Act, chapter 93, Revised Statutes of Canada, 1906, is pleased in view of the labour conditions and of the probable supply and demand for labourers in Canada during the coming winter, to order and it is hereby ordered that in the case of immigrants arriving at Canadian ports between the 1st day of January and 15th day of February, 1909, the immigration agent at any port shall require every immigrant, male or female, 18 years of age or over, to have

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in his or her possession money to the minimum amount of \$50, in addition to a ticket to his or her destination in Canada, unless satisfactory evidence is furnished that the immigrant is going to some definite employment, or to relative or friends already settled in Canada who would take care of such immigrant and that on the last mentioned date the money qualification above prescribed be reduced to the minimum amount of \$25 for each immigrant and so remain until further ordered.

· RODOLPHE BOUDREAU,

*Clerk of the Privy Council.*

· The Honourable

· The Minister of the Interior.

The evident intention of the above mentioned regulations has, in my opinion, been effected. Though there was a tendency in some quarters to construe these regulations as wholesale restrictions, and an indication that Canada wanted no more emigrants, subsequent facts clearly show that during the last fiscal year Canada received as many emigrants as she required, and who could be suitably settled in the Dominion, and the percentage of undesirables was reduced to a minimum.

In this connection I am pleased to be able to report that the various emigration societies especially affected by the order in council of the 25th February, 1908, have, without exception, loyally accepted the conditions imposed by the said order in council, and while realizing the duty of this office to strictly carry out these regulations, the method of doing so did not necessarily tend to prejudice the existence or continuance of such societies' propaganda. The societies in question undoubtedly sent much diminished numbers to Canada, and their funds were appreciably diminished accordingly, but their officers speedily realized that the regulations were imposed not only as a safeguard against undesirable and unsuitable persons being admitted to Canada, but it was actually to the advantage of such intending emigrants as were rejected that they should know by the personal selection carried on through this office that there was little or no chance of their succeeding in Canada.

The above regulations of 1908, together with the general trade conditions, unquestionably affected the number of emigrants leaving these shores; but while the number is less, I submit that the figures are not in the least disappointing, especially when they convey the fact that the number was sufficient for Canada's needs during the year, and that the undesirable element had been eliminated to a great extent.

During the past fiscal year other portions of the British empire have entered the emigration field in active competition with Canada. The province of Ontario has opened a separate office in the city of London, and their officers very heartily co-operate with us in all necessary business matters. But some states of the Australian Commonwealth not only offer a bonus to booking agents, but on certain conditions give assisted passages to intending emigrants, and while the number that such states of the commonwealth can take each year is relatively small, yet there is a competition which has to be met, and after discussing the matter at length with our various agents, and with many booking agents, and discussing conditions under which work has to be undertaken to secure the desirable class required by Canada, I am firmly of the opinion that the payment of bonuses to licensed booking agents should be continued without change.

During the year our agents have continued the inspection of booking agents, and the reports have been placed on file with the department at Ottawa from time to time.

The continuance of the policy of sending successful farmer delegates to tell their personal story of success has been productive of excellent results throughout the British isles, and I am of the opinion that the policy in question should be continued next season. Strive as the department does to prepare literature absolutely correct in every detail, there, is perhaps owing to competition from other colonies, a lingering opinion among intending emigrants that government literature requires to be for-



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tified by the personal opinion of some actual settler or farmer from Canada, with whom they can converse. The type of farmer delegate sent during the past year has been all that could be desired.

The demand from school children for the School Atlas has been very great during the past year, and it has been the ambition of agents to cultivate the personal application of school children for this valuable adjunct to their education. The Wall Map of Canada, which was a splendid advertisement by its free distribution to schools, should, in my opinion, be followed by a pictorial chart, similar in size and displaying by illustrations and reading matter the principal resources of Canada. These I feel satisfied would be very heartily welcomed by the many thousands of school-masters throughout the British isles as a method of educating the children.

While it is self-evident that the magnificent display provided by the Canadian government at the Franco-British exposition held in this city during 1908, induced a wide-world interest in Canada, and unquestionably maintained a foremost position amongst the world's exhibitors, it is apparent that the full beneficial results of that exhibition cannot be counted observable in the first or second years, indeed one cannot say where the effect of that magnificent display will end.

The special efforts required of our agents during the past fiscal year in order to secure suitable and deter unsuitable emigrants from going to Canada, have been successful and creditable. All the agents have transacted the business of the department during the past fiscal year with much business ability and great personal tact and energy. The correspondence received has had immediate and careful attention, and their extensive distribution of literature resulted frequently in their being short of this material. I would respectfully urge that literature of an inexpensive kind in very large quantities be supplied for the purposes of work on this side of the Atlantic.

The inspection of out-going emigrant steamers from London, Liverpool and Glasgow has been continued by our respective agents at these ports, and a statement concerning each such steamer carrying emigrants has been forwarded to the department at Ottawa.

I have much pleasure in recording the cordial co-operation which this office has received from the Imperial Government Emigrants' Information office, and the Board of Trade office. The latter department controls the issuing of licenses to booking agents, and it is a special duty to see that no booking agent takes advantage of any intending emigrant. I am pleased to report that our system of inspection is such that seldom, if ever, is it necessary to discipline or criticise booking agents in this respect. The transportation companies are fully alive to the necessity of continuing this policy, and without hesitation have agreed to the suggestions made by this branch of the department.

In addition to the general supervision of all emigration work (except in France) on this side of the Atlantic, the staff in London have had special charge of the London agency district, consisting of fifteen counties, with an enormous population, and during the past year there have been distributed from this office (not including those sent to other agencies), by correspondence, over the counter, and through the steamship companies in the London district, nearly half a million pamphlets of various kinds.

Twenty thousand and forty-one persons visited the London office during the past fiscal year to make personal inquiry, and discuss proposed emigration, &c., and a reasonable estimate, based on actual count for several days, shows that nearly a million people stop to inspect our window display in Charing Cross.

During the year nearly 62,000 attachments have been made to the files in the London office alone.

All the provinces of the Dominion, with the exception of Manitoba, have furnished this office and our agencies with large quantities of up to date literature, specially informing the public regarding their respective provinces, and so great has been the demand through our correspondence for the literature that we are constantly requi-

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sitioning further supplies. It is gratifying to realize that the auxiliary efforts of the various provinces of the Dominion, made available through the extensive propaganda of this branch of the Department of the Interior, have reached a large number of people to whom otherwise the name of a province in Canada would have no significance.

The provinces of British Columbia, Ontario and Nova Scotia by their excellent special fruit and vegetable exhibits last year created an attention regarding these branches of agricultural work which must produce substantial and favourable results. With all the provincial governments and the agents thereof in the British isles the federal government agents maintain the most cordial co-operative relations.

The steamship and railway companies operating to and from Canada have through their officers earned the just appreciation of the department for their assistance in many ways in the work of the department, and I have continued to assure them that they may depend upon the hearty sympathy of the department in the work of transporting desirable passengers to the Dominion.

In view of the very large and successful emigration of children to Canada I have taken advantage of opportunities, when time permitted, of visiting industrial, training and other schools from which the children were selected, and in company with Mr. G. Bogue Smart, the inspector of British immigrant children and receiving homes, gathered a large amount of information which will the better enable this office to make careful selection before consenting to the emigration of such children. The reports of the special inspection of such children have been received with much gratification by public officials and others privately interested in this work in the British isles. Considering the great number of applications received by the department for such children from very desirable citizens of Canada, it is apparent that there is a large field for this class of emigration, and the satisfactory reports which have been received from the department, after inspection of these children in their foster homes in Canada, appeal to the British public with much credit to the department.

In connection with your lordship's multifarious duties, connected with the important office of High Commissioner for Canada, the personal, kind attention you have been able to give at all times to the emigration branch of the public service is at once an evidence to the department of your appreciation of the great value that branch of the government work is to the Dominion of Canada, and your determination not to spare yourself for Canada's sake. I beg to offer my personal thanks to your lordship for very special consideration at all times.

Your obedient servant,

J. OBED SMITH,  
*Assistant Superintendent of Emigration.*

## No. 2.

### REPORT OF A. F. JURY.

OLD CASTLE BUILDINGS, PREESON'S ROW,

LIVERPOOL, April 1, 1909.

The Assistant Superintendent of Emigration,  
11 and 12 Charing Cross, London, S.W.

SIR,—When all the circumstances are taken into consideration, I think the result of last year's work has been most satisfactory, and while the numbers have not been as large as in the two previous years, the quality is much improved, and their usefulness to Canada greater than in any previous year of my experience. The new departmental regulations have enabled us to exercise a strieter supervision of the charitable society class, who frequently are not well fitted for pioneer farm work.

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They have also dissipated the idea that prevailed to a certain extent in this country that Canada was so anxious to obtain population that she would receive the undesirables from the police courts and the slums. In most cases the man who is unable to make a living in this country will be unable to do so in Canada, but the man who has been able to make a living here and save enough to have twenty-five dollars, in addition to his inland railway fare to his destination in Canada, is most likely to be able to do much better there, and is not only a valuable addition, but a good advertisement for Canada. The extension of the period during which undesirables can be deported, which I understand is proposed, will, I think, act as a deterrent to people who want to get rid of their ne'er-do-well sons by shipping them to Canada. This class of emigrants not only gives Canada a bad name when writing to this country, but their lazy, drunken, shiftless habits give Englishmen a bad name in Canada, and cause the impression to get abroad that they are not wanted there.

There are thousands of village clubs and reading rooms in this country that offer a good field for propaganda work if a suitable handbook of Canada was published and circulated among them. A revised edition could be issued every year to keep the statistics up to date. By this means we should reach the class most required in Canada at the lowest possible cost. This work could be followed up by the agents in this country sending all their old Canadian newspapers to the reading rooms that receive our handbook, which would have the effect of keeping the interest in Canada alive all the year round.

I must again emphasize the necessity for a good supply of Canadian agricultural products, with special reference to choice fruits and eorn eobs in the husk and on the stalk, to be exhibited in the agency windows and at the various agricultural shows. There is nothing that tends so much to disabuse the public mind here with regard to the Canadian climate, as exhibiting products that cannot be grown out of doors in this country.

I would also again take the liberty of suggesting the issuing of a double crown coloured poster respecting farming in Canada, with a space left at the bottom for the local steamship agent's name and address. If this was done the local steamship agents would not only show them in their windows in the principal streets of the cities, towns and villages of the United Kingdom, but they would go to the expense of posting them throughout the British isles.

There has been little demand for lectures this season, and those I have delivered have been poorly attended.

The agricultural shows at which I have exhibited have been well attended and a large amount of literature has been distributed, but the supply of government pamphlets for this purpose has not been equal to the demand, and I have had to distribute a large amount of steamship literature, which is not as satisfactory as having our own.

The letters of inquiry as a result of our advertising have been disappointing, and I think the best method would be to use only the great papers that are noted for being the medium through which the most successful business men reach the public, these naturally being the papers that people read who are looking for opportunities to improve their condition.

The number of souls on whom bonus has been claimed during the past year, through this office, was 638.

The work of receiving and handling the deports has increased very largely during the past year.

Mr. Edwin MacLeod, my assistant, made a trip to Canada during the year and visited all the leading points. While he has always been efficient and useful, his trip has made him far more helpful in the work.

Your obedient servant,

## No. 3.

## REPORT OF L. BURNETT.

16 PARLIAMENT STREET,

YORK, March 31, 1909.

J. OBED SMITH, Esq.,  
Assistant Superintendent of Emigration for Canada,  
London.

SIR,—I have the honour to submit to you my annual report for the year ending March 31, 1909.

Emigration from this country to Canada has been somewhat checked during this year, owing to the depression in America affecting Canada, and reports that prevented many people from going who otherwise would have gone. I find that the greatest drawback to emigration from this country is the lack of funds by the parties who are willing to emigrate, and who would undoubtedly make good citizens for Canada, if once they were in the country where there is plenty of scope for their energies and so many golden opportunities for them to possess their own land and become independent in a few years by exercising good judgment and frugality. Another reason why the agriculturalists and domestic servants are not leaving this country for Canada in larger numbers is on account of the wages here being increased, so that there is very little difference between the wages in England and Canada at the present time for good servants of either sex. The agriculturists in this district make very suitable settlers for Canada, and very few of them fail to make a success of life there. This year I have had a great many young men visit this office who have only been in Canada a short time, and have come to England to spend the winter, and induce others to return with them. In one case a young man took back with him seven farm hands, and all purposed taking up land. The booking agents in my district have been a little discouraged at the numbers going to Canada, compared with two years ago, and to a great extent they attribute this to the restrictions imposed by the Canadian government, but the latest reports from them are encouraging, and they are looking forward to a brisk business this spring. I have visited the booking agents whenever I deemed it necessary, and endeavoured to co-operate with them in every possible way to secure the right class of emigrants. This winter my district has been well covered by lectures and farmer delegates, but the booking agents have not been so enthusiastic in arranging for lectures, as owing to business being slack they did not care to go to too much expense.

The geography of Canada is being taught in all schools this year, and I have numerous applications every day from school teachers and scholars for copies of our Canadian atlas. I comply with their requests as far as possible, thereby getting the parents interested, which may ultimately result in their making their homes in the 'Land of Promise.'

Your obedient servant,

L. BURNETT.

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## No. 4.

## REPORT OF G. H. MITCHELL.

139 CORPORATION STREET,

BIRMINGHAM, March 31, 1909.

J. OBED SMITH, Esq.,

Assistant Superintendent of Emigration,  
London.

SIR.—I beg to submit my report for the year ending to-day.

During 1908 there was a very heavy decrease in the number leaving for Canada owing to the very alarmist reports which reached this country of the state of the labour market in the Dominion; that the depression was caused by non-Canadian influences which affected the rest of the world was of course immaterial to the man seeking work, but the accounts received such extraordinary publicity that the effects will take a considerable time to disappear. The department's restrictive regulations had a tendency to confirm the impression that no more emigrants were wanted, the general public failing to make the discrimination that was necessary accurately to understand the position. However, the regulations ensured that of those who did sail a greater proportion than ever before was desirable from a Canadian standpoint. This spring a much better feeling prevails and I anticipate that the year will show greater returns than 1908 although still much below the figures of 1907. Competition has become keener on the part of the Australian colonies and New Zealand, and they are securing an increasing number of emigrants of the kind most wanted in Canada; their literature is very attractive in appearance as well as in other ways, their exhibitions of produce are particularly well done, and their commissions to booking agents equal to our own. It will be necessary to continue to use every effort to keep Canada to the front.

The newspaper press in my district as a whole has not been unfriendly; some of the papers at times insert unfavourable letters from men who have returned and from dissatisfied settlers but they show a willingness also to give the other side of the case.

My time has been fully occupied in the usual way, answering correspondence, interviewing personal enquirers, visiting booking agents, attending agricultural shows with exhibits, arranging itineraries for delegates, and for the motor and horse wagons, and giving and arranging lectures, the lantern slides being in constant use during the winter season.

A good start has been made in securing correspondents in the villages and some of these have already proved very useful.

The office daily record shows an increase in the number of communications received, 5,776 against 3,803, and letters sent out 6,604 compared with 4,207 last year, but the callers were fewer, 2,930 against 3,965.

Acting under instructions I paid a visit to the Dominion during August and September, and I was glad to have the opportunity of renewing my acquaintance with various places, of seeing the developments which had taken place since my last visit six years previously, and of going through districts which were not at that time opened up. It gave me a chance of looking up many men who had gone out on my recommendation; some of them were working on farms and others were now on farms of their own, and it was very gratifying to find them without exception doing well. Needless to say the trip enabled me to gather much fresh material which has already proved invaluable in my work.

Your obedient servant,

G. H. MITCHELL.

9-10 EDWARD VII., A. 1910

## No. 5.

## REPORT OF H. M. MURRAY.

EXETER, March 31, 1909.

The Assistant Superintendent of Emigration,  
London.

SIR,—I have the honour to present my annual report for the year ending March 31, 1909.

Like other districts there was a distinct falling off in emigration to Canada during the year just closed. I, however, do not consider this as being a drawback but rather a help, as it has enabled the general public in this country to understand that Canada will no longer admit into the Dominion the undesirable, unwilling to work, and shiftless men from Great Britain, but rather have the numbers reduced and receive emigrants of a higher standard both morally and physically. Bearing this in mind as being the desire of the minister and the department, I have during my periodical visits to booking agents endeavoured to impress upon these gentlemen that we are only desirous of securing men and women of the best class, and of the former only those willing to go on the land, and the latter for domestic service, of course keeping before them the fact that there are many openings in western Canada for men and women with capital and grit. I am pleased to say that my efforts directed on this point have been highly successful, many fine specimens of the typical agriculturist having gone out from the west of England.

I think shipping agents now thoroughly understand the class of men required in Canada. They are not so prone, as was the case with many of them some years ago, to accept any one as a passenger to Canada, caring little or nothing as to his future or progress so long as a commission was received on the booking. The certain amount of control the bonus arrangement gives to government officers over these agents has in my opinion had a very salutary and steady effect.

The counties of Somerset, Devon and Gloucester have this year, as during 1907, given the best results. In this connection I may say that on one steamer alone, which sailed on the 12th inst., there were over 150 good sturdy farmers and farm servants, secured between Plymouth and Bristol, many of them, especially from Somerset, having capital at their command and intending to settle in southern Alberta. These men will be an acquisition to Canada. The returns from Gloucester do not give a fair estimate, as the Canadian Pacific Railway Company, who have a branch office in Bristol and to whom no bonuses are paid, booked over 800 passengers, of whom many belonged to the bonus classes.

In the county of Wiltshire we have a decided increase in the farming class of bookings, and a decrease of 25 per cent in Hereford. In the latter county there is a considerable acreage taken up with apple, pear and plum orchards. It is also to a considerable extent a dairying and cattle raising centre. Farmers are, as a rule, pretty well off and labourers are paid fair wages. We did well here a couple of years ago and I am confident good returns will come again.

Dorset is purely a pastoral and dairying county, and we have never been able to secure large numbers there, although I am aware that several from Dorset book their passages at Bournemouth, in the neighbouring county of Hampshire.

In Cornwall there are a sturdy set of men engaged in the slate and tin mines. A few years ago many of these mines were closed, owing to want of demand for the output. Now, however, it is the opposite. Many mines which have been closed for years are working full time and workers are scarce.

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South Wales has been fairly good, but as you are aware coal is the principal product, the country from Swansea to Newport, Mon., being honeycombed with mines, Swansea itself up to Llanelly in Carmarthen being occupied in the manufacture of tinplate. On the whole in this part of the country at least 90 per cent of the people derive their living in some way or other from the industries mentioned. Of course a great many of these people, especially the miners, have in early years worked on the land, but owing to higher wages drifted to the mines. In times of depression quite a number have gone to Canada for farming purposes, but recently high wages at home have been received, preventing emigration, although quite a number still go out to the mines in Pennsylvania, U.S.A.

The general work in this office has been carried out in the usual manner. Every attention has been given to callers and correspondents. During the year 3,281 persons called for information; 7,563 letters were received, and 8,651 sent out. Pamphlets are sent out with every letter as also an inquiry form, asking the addresses of friends who may be interested in Canada, to whom also pamphlets are sent.

The following agricultural shows were attended :—

Somerset county, Devon county, Bath and West, Gloucester county, Hereford and Worcester and Wiltshire. As a rule favourable weather prevailed and large quantities of literature were given away; on the whole I should say not less than 80,000 pamphlets. At these shows we come into direct contact with the special class we are after, viz., the agriculturists, and I am certain that by means of these meetings, where people come around the stand, examine our samples and get direct information, many are induced to make their homes in Canada.

The removal of our office from Cardiff, Wales, to the centre of the west of England has resulted in nothing but good. With a couple of capital show windows, exhibits of grain, grasses, fruit and minerals, helped by attractive pictures and transparencies of Canadian scenery, we have, especially on market days, a continuous crowd around.

Mr. Aylesworth gave several lectures in my district, as did also one or two gentlemen from British Columbia, the halls as a rule being crowded.

Farmer delegates were also with me, going around to the booking agents, seeing inquirers, &c.

Our sets of lantern slides have been loaned out for about sixty lectures by clergymen, school teachers and others, and as these lectures are nearly all given in young men's institutes, or such like meeting places in the country districts much good should result.

Fully 10,000 copies of the Canadian atlas have been so far given away, as also some thousands of wall maps. When these publications were announced applications came pouring in, and I received as many as 540 in one day. The school children and teachers seem to appreciate them, and either they or the teachers write that they are now for the first time taking Canada as part of their scholastic course. This is satisfactory. I was glad to have the privilege in July last of paying another visit to the Dominion. I travelled from Quebec to the coast through all the western provinces and the fruit-growing districts of British Columbia. On my return journey I was able to see the splendid harvest of western Canada gathered in. I visited farmers in every district, being driven over the country by government immigration agents. Much information of a practical nature was gained which since my return I find most helpful in my work. While in Canada I met quite a number of successful farmers from my district who blessed the day they went to Canada.

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## ACREAGE and Population of Counties in my District.

| Counties.               | Acreage.  | Population. |
|-------------------------|-----------|-------------|
| <i>South Wales—</i>     |           |             |
| Brecon.....             | 473,087   | 53,951      |
| Carmarthen.....         | 464,587   | 123,570     |
| Glamorgan.....          | 576,537   | 866,250     |
| Pembroke.....           | 357,118   | 82,424      |
| <i>West of England—</i> |           |             |
| Cornwall.....           | 886,384   | 318,591     |
| Devon.....              | 1,633,269 | 664,697     |
| Dorset.....             | 624,341   | 199,968     |
| Hereford.....           | 539,226   | 112,549     |
| Monmouth.....           | 395,849   | 316,864     |
| Somerset.....           | 1,070,078 | 466,193     |
| Wilts.....              | 809,220   | 263,944     |
| Gloucester.....         | 712,757   | 648,627     |
|                         | 8,542,453 | 4,117,628   |

Your obedient servant,

H. M. MURRAY.

## No. 6.

## REPORT OF JOHN McLENNAN.

ABERDEEN, March 31, 1909.

J. OBED SMITH, Esq.,

Assistant Superintendent of Emigration,  
London.

SIR,—I beg to submit the following report of the work of this agency during the year ending March 31.

The year opened in the midst of the great commercial and industrial depression which has prevailed everywhere for the past eighteen months. This stringency had the effect of largely stopping the movement from this district; even the classes for which we had openings were sceptical, and it was difficult to convince them that there was any work to be had, in view of the many conflicting reports and the requirements of the department. It made it often disagreeable for myself and other government representatives on account of the wide publicity given by newspapers to these reports, and no matter how strenuously we might deny the statements, the public were disposed to accept the press news in preference to our denials.

I am glad to report, however, notwithstanding the difficulties, that a large number of desirable farmers and farm servants left the north part of Scotland during the past year for Canada. Since the gathering of harvest, when it became an assured fact that the country would have a bountiful supply of money and that there would be extensive building of railroads and other public works during 1909, I have used every effort to revive the interest in my district.

During the past four months I have delivered 28 lectures, illustrated with lime-light and cinematographic views, and addressed over 15,000 people, many of those lectures having been given in purely agricultural districts, while all of them have been attended by a large number from the country. Besides directing attention to



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the great possibilities of Canada, I have been enabled by those lectures to partly neutralize the growing opposition among many people here to our propaganda. I tried to impress upon the audiences that our aim is not to depopulate Scotland, but to divert the stream of emigration from the centres from which it has been flowing for the past forty years, to our own shores.

I am glad to report that I have been enabled to secure the hearty commendation of the leading men in all the large centres by these lectures.

The outlook for the present year is exceedingly promising, and I look for a large increase over that of last year. I am hopeful that the number of agricultural labourers and farmers from my district will even exceed the number of the banner year 1907. While we have opposition from some of the leading farmers, on account of the heavy drain made upon agricultural labourers, the feeling on the whole is very well disposed towards Canada, as nearly every family in my district is interested through relatives or friends.

Your obedient servant,

JOHN McLENNAN.

## No. 7.

## REPORT OF M. McINTYRE.

35 AND 37 ST. ENOCH SQUARE,

GLASGOW, March 30, 1909.

J. OBED SMITH, Esq.,

11-12 Charing Cross,  
London.

SIR.—I beg to report that during the greater part of the year, the depression of last season still being felt, Scotch emigrants' attention turned quite largely to other fields than Canada. The monetary regulation has kept some back, but this is cutting two ways; while it has kept out some who would make good settlers, it has also kept out a good number of an undesirable class. I am pleased, however, to report that during the last few months prospects seem much brighter, and there is a splendid class going.

The trip to Canada during the year, of the Scotch Agricultural Commission has been helpful to emigration, as most of the members have been giving lectures on Canada as seen by themselves. To aid these men in their lectures, I have lent them lime-light views with which to illustrate their remarks regarding the different localities.

The visit of the Canadian enrlers during this winter was very opportune, as Canada was being brought largely before the people, and this, followed by lectures, and the visits of Canadian farmer delegates to Scotland, along with the usual efforts from this office, has given a stimulus to emigration, and the tone of things is considerably improved.

The policy of supplying atlases and wall maps of Canada to schools, is one which should bear fruit in the future. The schooling of the young is the best way to provide for emigration in the coming years, and through the children, knowledge of Canada reaches many homes that otherwise would be missed.

Distributing literature from a wagon is a splendid means of getting in touch with the agricultural classes, but the best kind of wagon is a light one that can depart from the main roads, getting into the less frequented parts.

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With a view to keeping Canada and her advantages before the public, I have attended agricultural shows and exhibitions, having exhibits at same, distributing literature from these stands, and giving information to all inquirers. I have given lectures in different localities, have also rendered assistance to all those I knew intended giving lectures on Canada, and have found it beneficial to work in conjunction with the clergy, as I find a great number of them are favourable to Canadian emigration. In fact, I have used all means so far as my ability goes, to further the object of this office.

Your obedient servant,

M. McINTYRE,  
*Canadian Government Agent.*

No. 8.

REPORT OF E. O'KELLY.

CANADIAN GOVERNMENT OFFICES,  
44 DAWSON STREET, DUBLIN, March 31, 1909.

The Assistant Superintendent of Emigration,  
11-12 Charing Cross, London.

SIR,—I beg to present my twelfth annual report, covering the period from March 31, 1908, to March 31, 1909.

The work of my office has increased satisfactorily since the Dublin office was re-opened in September, 1907.

|                                     |       |
|-------------------------------------|-------|
| Number of letters received. . . . . | 2,557 |
| Number of letters sent out. . . . . | 3,895 |
| Number of callers. . . . .          | 2,491 |

In addition to attending at a number of the most important show fairs, with my stand of exhibits and literature, I have also attended a number of stock fairs, had literature distributed amongst the farmers with whom I spent a considerable portion of the day comparing farming on rented and highly taxed land in Ireland, and farming on free and lightly taxed lands in Canada. The advantage Canada offers to farmers in the much smaller amount of capital required to stock land there than in Ireland, next to being able to acquire free farms, appears to impress Irish farmers most and I am sure will prove a great inducement to many of them to emigrate. In very few instances have I had a pamphlet left at the end of a fair day and my supply, a fairly liberal one, has often not been equal to the demand.

I have supplied schools and reading rooms with the wall map, atlas, and larger pamphlets, where those institutions are not dominated by the Nationalist party, who are now more anxious than ever to keep people in this country.

In the past twelve months I have inspected 157 booking agencies and forwarded my reports on them to you. I found the agents as a rule intelligent men, but most of them careless and indifferent to the booking branch of their business, and notably to advertising Canadian emigration in any shape. In this connection I may mention that while the American lines are largely advertised at most of the railway stations, in the provinces of Leinster and Munster, and the Australian and New Zealand lines in many stations, the Canadian lines are totally unrepresented, a grave lack of enterprise to my mind, and a circumstance I have brought to the Canadian steamship companies' notice, but so far without result.

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The country people, who are always ahead of their trains when travelling to fairs and markets, if we believe in advertising, must be influenced by the splendid posters of the American lines, which they see at every station. The agents show more interest in their work, and more care in their correspondence since I commenced my visits of supervision and encouragement to them. The class of emigrant leaving Ireland for Canada is still improving, but the number this year falls far short of the season of 1907-8, in fact the total emigration from Ireland has not been so low for fifty years. This decline is mostly the result of the state of unrest and excitement caused by the continuous change in the land laws, aided by the depression in Canada and the United States, but these causes will pass away, and the people will continue to leave the country as before. In the poor districts the landing money required has also proved an obstacle to emigration. With reference to the landlord class there can be no second opinion, but that they will leave Ireland in large numbers, for the oversea states of the empire, when they get paid the price of their properties by the government. They will all be possessed of capital varying in amounts from hundreds of pounds to thousands, and will prove a valuable addition to the population of the country they select to settle in. The callers at my office are largely composed of this class.

I have had no complaints from Irish importers of Canadian apples in the past year, and those I have conversed with appear quite satisfied with their purchases.

Your obedient servant,

EDWARD O'KELLY,

*Canadian Government Agent.*

## No. 9.

## REPORT OF JOHN WEBSTER.

CANADIAN GOVERNMENT OFFICES,

17-19 VICTORIA STREET, BELFAST, March 31, 1909.

J. OBED SMITH, Esq.,

Assistant Superintendent of Emigration,

11-12 Charing Cross, London.

SIR,—I beg to submit my report for the year ending March 31, 1909. My work during the summer season was divided between official duties—visiting steamship agents—and making exhibition of Canadian products at various agricultural shows. During the year I have placed 246 school maps and 3,577 copies of the school atlas. The total number of pamphlets distributed through the office, and in conjunction with the exhibit wagon, amounts to 36,215 for the year. The number of letters received was 2,656; outgoing letters, 4,329; callers at office, 8,686. Extensive alterations in the office have been carried out under my supervision, the landlord being responsible for a share of the cost; the office now presents a good appearance and is in every way satisfactory. I have called on nearly every agent of importance in my district, and with these have discussed matters of mutual interest. I have generally found them willing and anxious to carry out any useful suggestions I make to them. It would be a wise policy on the part of one or more of the steamship companies to revise the list of their agents; they could with advantage weed out many who are making no effort, and who take no interest in their work. Sometimes in a small town you will find two or three agents for same line, where one good man would do the work much better.

9-10 EDWARD VII., A. 1910

I made exhibition at six important fixtures, as follows:—

- Belfast spring show, 20th, 21st, 22nd May.
- Ballymena summer show, 3rd June.
- Portadown summer show, 10th and 11th June.
- Armagh summer show, 24th and 25th June.
- Omagh summer show, 15th and 16th July.
- Belfast summer show, 23rd and 24th July.

At the first of above I made use of the elaborate 20-ft. stand supplied by the department, and had a most attractive display. At the five subsequent shows I found it necessary to use a smaller stand, as the large one would not fit into the tent space provided. It would be an advantage to me if the large stand were say, five feet shorter. At all the shows I was ably assisted by our Mr. John Mullan. Inquiries were numerous, and a large amount of literature was distributed; naturally at an agricultural show we meet the most desirable class. For exhibition purposes, I am frequently handicapped owing to the lack of good material; this year the supply of stuffed wild fowl received, was most acceptable, and made an attractive display. It would be very helpful if, at short intervals, a small consignment of selected fruits were sent over, this would be useful for the shows and afterwards serve for display in the windows of the office. Some set up fish and small animals would come in for the same purpose.

On May 5, Mr. George Robinson started out on his itinerary with team of horses and democrat wagon exhibit, he was out almost continuously until November 14, a period of over six months. The counties visited were Armagh, Antrim, Down, Derry, Donegal, Cavan, Monaghan, Fermanagh, Leitrim, Longford, Louth, Westmeath and Meath. We endeavoured to arrange that his visit to a town or village should be timed with the market or fair taking place that day. He was therefore continually meeting throngs of agricultural people and had a fine opportunity for distribution of literature with which I kept him supplied. The wagon accomplishes a most useful purpose.

During the winter I fulfilled four lecturing engagements, and have others still in view. Acting on your authority I have recently purchased a full lecturing outfit, including lantern and stand, portable screen, and acetylene generator; I am very glad to have these as I am now in a position to accept invitations from anywhere, including, which is important, outlying rural districts.

I am glad to again report that the calling of Canadian Pacific steamers at Belfast, has, for the company, proved a decided success and a venture which they should have no reason to regret, as each ship secures a fair number of passengers. By the last sailing, on March 18, the ss. *Lake Champlain* took 107 emigrants for Canada. The fine boats of the Allan line from Liverpool and Glasgow, calling at Derry, are also getting a fair share of the business.

I was pleased, this spring, to have the services of Delegate Mr. John Kennedy from Edmonton, Alta. He is one of the best delegates ever placed under my direction, a north of Ireland man himself, having many friends and relatives here, and this being his third trip to Ireland as delegate, he is a well known and popular man amongst the farmers. While with me, I had a wide itinerary arranged for him. I trust his visit may prove useful.

My relations with the local press are cordial; I therefore experience no great difficulty in having interesting Canadian items, including copy of weekly bulletin received by the High Commissioner from the Minister of the Interior, appear in the leading papers. Naturally in a country like Ireland with a declining population, an emigration propaganda is not popular, but in the north the sentiment prevails, 'If they must go, let Canada be the selection.'

Your obedient servant,

JOHN WEBSTER,  
*Canadian Government Agent.*

## No. 10.

## REPORT OF D. TREAU DE CÉLL.

23 PLACE DE LA GARE, ANTWERP, March 31, 1909.

J. OBED SMITH, Esq.,

Assistant Superintendent of Emigration,  
London.

SIR,—I have the honour to submit my report for the year ending March 31, 1909.

The emigration from Belgium and Holland has not been so heavy this year as previously but it is pleasing to state that those who left for Canada belonged in every sense of the word to a better class of emigrants than ever before. This proves clearly that the importance of our country is beginning to be known more favourably every day, and that the Belgian people have confidence in its future. It is but just to remark that this is greatly due to the interest the primary or common school teachers in Belgium have taken in Canada, to the free distribution of our propaganda literature and the teaching of our geography, and to the numerous lectures delivered. The introduction of our propaganda literature in the schools commenced in 1905, immediately after the World's Expansion Congress at Mons, where the committee on education decided that it became absolutely necessary for Belgians to have a knowledge of the new countries, in order that they might be prepared to make a judicious choice if they should decide to emigrate, whether it be to seek their fortune as merchant, manufacturer or farmer.

This view was unanimously accepted and steps were taken to make the study of the different countries part of the educational course. I seized the opportunity which presented itself and immediately offered our atlases to a certain number of the teachers. Canada was the only country which at that time could boast of an up-to-date propaganda literature and the demands for it have increased yearly, from 22 in 1905 to over 3,200 schools now using the geography of Canada. Amongst these a good many are winter schools in farmers' communities, where young men from 16 to over 20 receive general instruction, together with lessons on agriculture, gardening, &c.

A few of these scholars left last year and others will leave shortly, and I am confident that they will make the best of colonists and will cause quite a number of their friends and relatives to follow them.

The month of March, being the first one favourable for emigration, promises a very good season. Many have already left and will be followed weekly by others, a certain number taking their families, while farmers and farmers' sons are going, to have everything in readiness to receive at the earliest possible time the rest of the family.

I consider that 25 per cent has been added since January to the number of emigrants of the nine previous months.

The Dutch emigration will also be much better than last year. Already a few families have sailed who had the proper means for settling and as they are generally good workers and sober men, I am quite sure that they will be a credit to their new country.

I have given fourteen lectures on Canada this winter, and besides this, no less than twenty have been given by teachers and private individuals, who either had visited Canada, had lived there or had made it a point to study it. As far as possible I have provided everything necessary for these lectures by giving special information and also sending views.

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I acknowledge with pleasure that the assistance I received from the teaching staff greatly facilitated my work. The reappearance of the monthly paper *West Canada*, which contains the most interesting up to date information concerning crops and values thereof, letters from Belgians and Dutchmen, the regulations and laws on emigration and Dominion land, have also been greatly appreciated and although it causes a surplus of work in one way, it facilitates it in another, the most important information being available to a great number of correspondents by this publication.

No special advertising having been done this year, the correspondence has been normal. The number of letters received during the year was 4,090, of which 3,015 called for an answer. I had interviews with 910 persons who visited the office for verbal information on Canada. Any others with whom I was corresponding, I always considered it my duty to meet before their emigration was completely decided, so that I might judge if they really were desirable emigrants, also to prevent long and tedious answers to inquiries. In order to attain this point the more easily I designed as place of meeting the town or city most centrally situated where I could meet a certain number of interested parties.

As the office work allowed me I visited the agricultural fairs in summer and fall to have propaganda literature distributed.

Your obedient servant,

D. TREAU DE CÉLLI,  
*Canadian Government Agent.*

#### No. 11.

#### REPORT OF PAUL WIALARD.

PARIS, April 1, 1909.

The Superintendent of Immigration,  
Ottawa.

SIR,—I have the honour to submit my report for the year ending the 31st ultimo.

Until last year, though the Canadian government did not encourage any but the agricultural class to emigrate, many other persons could set out with some degree of certainty of finding work immediately at remunerative wages. But now, with the marked decrease in construction work, and the invasion of our country by a considerable crowd of workmen of different trades driven from the United States by the industrial conditions in that country, Canada finds itself under the necessity of applying greater restrictions to those, other than agriculturists and domestic servants, presenting themselves as immigrants, and this, naturally, has caused a reduction in the volume of emigration from France to Canada.

Nevertheless, although in all the agencies there has been a very noticeable decrease in the number of departures, nearly 50 per cent in some cases, I believe that we have been very fortunate to keep up to figures which are not far from those of last year; the statistics tell us in what proportion.

Our work has not diminished, but the contrary. Canada is known better and better in France, and owing to the commercial convention between the two countries we have had still more requests for information than last year. Our correspondence has been about 12,000 letters, which shows the great favour Canada now enjoys here. If conditions continue to improve, of which there seems no doubt, this season will see a great number of settlers set out who are desirous of taking their share in the advantages offered by our country.

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I gave, and had Messrs. Geoffrion and Montpetit give, many lectures on Canada, economical, geographical and historic, setting forth all points of a nature to demonstrate well the prosperity of Canada in all its relations. Besides that we have distributed a large quantity of pamphlets which have contributed to spread the Canadian idea in the public mind, and to cause to spring up seeds which sooner or later will produce excellent fruits.

In this respect I was able recently to make an arrangement with the National Bureau of Popular Lectures, subsidized by the French government, and which counts among its subscribers ten thousand teachers and officers of the French army, to publish a lecture with photographic illustrations of Canada. I hope that this lecture will be given by a great number of these subscribers or by all, since on the one hand Canada is a subject of actuality on account of the recent commercial treaty, and since on the other hand all the subscribers to this publication belong to it only for the purpose of receiving each month a lecture all ready for delivery to their regular audiences, pupils or soldiers. I must add that no advertising appears to me so well calculated to show what our country now is and what it will be in the future.

I was authorized to go to Canada last summer to take personal account of the progress constantly realized in all parts of our country. I saw that the French settlers, spirited, energetic and knowing how to adapt themselves to the methods of work in the country, have succeeded quite perfectly, whether they settled in the province of Quebec or in the other provinces.

Your obedient servant,

PAUL WIALARD.

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# OPERATIONS IN THE UNITED STATES.

## No. 1.

REPORT OF W. J. WHITE, INSPECTOR OF AGENCIES AND PRESS  
AGENT.

OTTAWA, April 2, 1909.

The Superintendent of Immigration,  
Ottawa.

SIR.—The statistical portion of your report shows that the number moving across the boundary to Canada during the past fiscal year for the purpose of becoming settlers in this country fell a trifle short of sixty thousand, but it is so near this figure that there is reason to congratulate the agents who have had charge of the work of soliciting and securing so many and such a splendid class of settlers.

You also show in classified order the number who have entered upon homesteads. The aggregate wealth of these settlers is also given. There is no necessity for repetition.

Your attention is, however, directed to the fact that the number who have accepted the privilege of homesteading does not afford a fair basis of computation of the number that has moved across the border. The allurements of a free grant of 160 acres of land—such land as central Canada possesses—with the added opportunity to select an additional 160 acres, within a certain area, is tempting to a great many. But during the past year many more have preferred to purchase lands more contiguous to existing and projected lines of railway: the homesteader now has to make his selection some distance away, and many have gone back sixty and seventy and even a hundred miles. The land they get is fully as good and, with increasing settlement around them, it will not be long before they have a railway.

It is not alone to the personal stamp of the 59,832 new arrivals from the United States that your attention is directed, but, besides being men of splendid character, physically strong and of an integrity that comes from close connection with the uplifting surroundings of farm life, these people crossed the line bringing with them at a reasonable estimate, in stock, cash and effects, upwards of \$60,000,000. Not only this, but what is worth fully as much, they took with them the experience that years of life on the prairie of the middle west of the United States gave. This experience had taught them methods of farming that were readily adaptable to the central Canada farm; it was an experience that was not useful to them alone, but one that was made profitable by the settler from other lands, who did not bring with him the advantages that the experience of the settler from the United States gave; he was valuable as a settler not only for himself but the use he was to others less experienced. Conditions in his new life were so little different from the one he had left that no time was lost in adapting himself. He found that the manner of working the soil was similar, methods of cultivation the same, the principles of the laws were alike and it was as if he but moved from one part of his own country to another. As a rule he arranged his affairs so as to arrive at his new home just at the right time, so as to secure a crop the same year—probably a crop of flax—erect his house, send for his family and then count the months that would elapse before he could become a Canadian citizen. It is not only on the farm that the class of settler, of which this report speaks, becomes a strong factor in building up central Canada and Canada as a whole. The farmer from



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—county, Minnesota, is followed by the merchant and the tradesman with whom he has done business since he first came to the country from Ohio. Then the manufacturer, anxious to retain the trade of the people he has known for years, follows. Thus are these settlers helping to build up the towns and cities of central Canada, becoming part of the life that causes the hamlet to grow into the town, and so on. Pork-packing industries are now headed by American money; brick and tile plants are managed by men who have brought with them from Ohio, Nebraska and Indiana, the cash and the experience so necessary in establishing any enterprise. Mills of all kinds are erected and made to become paying institutions by the same forces.

The opening up of central Canada as a farming proposition seems to have come at the psychic period. With the rapid growth of the population of the United States and such a great percentage of it filling the cities, the time was certain to come when the energies of the farmer would become severely taxed to raise sufficient food-stuffs to provide for the millions that were dependent upon them. Lands that had in earlier years been prolific in their yield of wheat, oats and barley, had become drained of the elements that supplied the generating properties, and gradually, year by year, averages were growing less, and these fields were given over to corn and coarse grains. It was evident that some other source of supply would have to be discovered. True there was the height of land east of the Rockies. There, there was plenty of land, but while the soil might be of good quality, the indifferent climatic conditions made it impossible to grow grains without resort to the expensive methods of irrigation. Then central Canada was presented. The middle state farmer knew how to cultivate such soil, and he was anxious to repeat his earlier experiences on his old home farm when he raised large crops of wheat. When he examined he found Canada offered more than he expected. It offered broader acres, more tillable areas, long, level stretches of rich prairie land with subsoils the most suitable for the purposes to which he wished to put them. He could get more land of as good quality as he had ever worked, for lower figures. He could use his machinery to better advantage, and the man with the steam plough came forward and demonstrated what work could be done, and the steam plough is to-day one of the great factors satisfactorily introduced to the Canadian prairie by the American farmer. In every province they are now being worked. Splendid results in good yields of grain followed; the nutritious grasses gave the fodder that fattened his cattle without feeding any grain, the climate was what he had been led to believe, and in a short time his friends were advised that what the Canadian government agents had told him was true and that the literature that they distributed contained nothing of an exaggerated character. Conditions, such as I have set out, were healthful conditions, and were of prime assistance to the agent in his work during the past, as in previous years.

It has been the ambition of the United States branch of the service to make the year just closed the most successful of any, and while hoping that the showing has been satisfactory to the department, I wish to express to you, on behalf of the agents, their appreciation of the consideration that has been given by the department to such matters as were helpful to them in their campaign.

In past annual reports I have outlined as far as was practicable the methods that have been adopted in carrying on the work in the United States. These consist of making use of every means of publicity that is possible, with the dignity that should surround a work carried on under government auspices. Use has been made of the public press that reached desired communities; a series of four journals, in the smaller country weeklies, and in the county-town papers. These were run alternately during about six months of the year, beginning with November and closing with June. The replies to the advertisements were carefully answered, and literature mailed. In addition to this the work of the agent consists in visiting the different communities where interest in Canada is shown, holding meetings and in other ways giving the information generally desired by the prospective settler. During the fall, exhibits carefully

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prepared by the branch at Winnipeg have been put in place at different fairs throughout the states, and the results of this class of advertising are quite far-reaching. In some of the schools throughout the country we have been permitted to place exhibits of grain in the straw and specimens of the different wild and cultivated grasses. But these are only a few of the various methods adopted to bring Canada to the attention of the United States public. During the past year the National Editorial Association of the United States made a tour through the prairie provinces visiting some of the most important agricultural and commercial centres. The party comprised newspaper men from every state of the Union, and the resultant 'write-ups' were very interesting and valuable. Other interests in rivalry with ours have carried on a vigorous campaign to secure settlers for the lands in which they are interested, and this too in the districts and amongst the people our agents hoped to secure. It is safe to say that the figures of 59,832 for the past fiscal year would have been considerably increased but for this fact. During the past year the movement to Texas has fallen off, and we now find that the attention of the land agent is directed elsewhere. In the western and Pacific coast states, in the Dakotas, Montana, Washington, Idaho, Arizona, New Mexico, Nebraska, Minnesota and Wisconsin, scarcely a month passes but the announcement is made throughout the press that large areas of lands have been thrown open for settlement. These comprise Indian reservations, lands that were formerly fitted only for grazing, but with irrigation plants at various points are now made possibly valuable, and tracts that have been held by railways. The United States government has spent within the past few years millions of dollars in ditches, reservoirs, and whatever else was needed in the reclamation of lands once considered barren. Since the Canadian west opened up the splendid inducements its lands offer, the United States government has been very active in its efforts to open up lands, and hence the big irrigation projects, &c.

For every big irrigation project the government reclamation service has appointed a manager. The manager is an expert irrigationist and knows all the ins and outs of this kind of cultivation. Before he can have the job he must have learned all this by careful training and hard experience.

It is the business of the manager to guard against the failure of any settler in his district. He is there to tell the newly arrived settler what machinery to buy, how to build his laterals, how much water to let on to his land, how to plough and cultivate his soil and what he should plant. Considerable money is required to undertake this class of farming, however, and only the man of means can take advantage of it. There are also so many conditions surrounding the purchase that careful thought has to be given before entering upon it. One project is on the lower Yellowstone, which embraces an area of 67,000 acres. At the time of writing 700,000 acres of government land, located in three Indian reservations, are about to be thrown open for settlement. The greatest portion of this land is located on the Flathead reservation, just north of the Northern Pacific Railway tracks and west of the main range of the Rocky mountains, in northwestern Montana, where about 450,000 acres will be allotted to settlers. Another tract of 150,000 acres has been thrown open in Shoshone Indian reservation in Wyoming. It is said, too, that large tracts are to be opened up in Arizona, which will be sold at \$1 an acre, with settlement conditions.

In Mexico plans are now under way for opening up 1,000,000 acres of land, and it is said that some of the irrigation canals used in this will be so large that it will be possible to use them for transportation purposes.

The United States Reclamation Service announces the completion on May 1, 1909, of the Pathfinder dam, which has been built on the North Platte river, Wyoming. It consists of a vertical concrete-rubble arch, 215 feet in height, which closes the river where it flows through a narrow gorge. The length of the dam on its crest is only 500 feet, yet the storage capacity is 1,025,000 acre-feet or 358,000,000,000 gallons. Its great capacity is shown by comparison with the largest reservoirs in the east, of which

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the Wachusett dam has a capacity of 192,000 acre-feet, the Croton dam of 92,000 acre-feet and the Ashokan dam now under construction of 269,000 acre-feet.

It will be seen from these facts that there is still a large quantity of vacant land in certain of the states, and that no time is being lost, and no effort spared to bring these lands into service.

But there will still be enough people for all, for we find a great and a growing interest in farm life. The young man who left the farm years ago to take up city life does not find it as congenial as he hoped. Farm life to-day is free from many of the difficulties and drawbacks it then possessed, and the splendid returns that are now realized in the pursuit of agriculture are bringing back to that life those who once discarded it, and others are now giving the home on the farm earnest consideration. It is just a matter of decision now. Shall it be the land in the arid reclaimed west, that requires considerable money to operate it, a lot of hard work to keep the farm in condition, or a farm in central Canada, that requires but little hard work to secure splendid results and the opportunity to enjoy a climate that is unanimously considered to be healthy and otherwise desirable?

In the course of the work of the agents in the different states it is found that there are a great many former Canadians, and a large number of them devoted to agricultural pursuits. Special directions have been given from time to time that they be advised of the opportunities that Canada offers as a field for farming efforts, and it is a pleasure to report that great success has followed this line of the work. The reports of the department reveal more clearly than I shall attempt to show here how successful this has been. Amongst the French Canadians who are to be found both in the eastern, middle and western states, specially qualified men of their own extraction have had their labours well rewarded, and have induced large numbers to return to Canada. Some have gone to the farms of Quebec, while others have taken up homesteads and purchased lands in central Canada. What they have accomplished there is carefully watched and noted, and the reports sent back to their friends. This work is valuable and the results have been such that I strongly recommend its continuance.

In conclusion I may say that the correspondence at the various offices during the past winter months satisfies me that the 59,832 settlers from the United States during the past fiscal year will be increased to 70,000 in the next.

Your obedient servant,

W. J. WHITE.

No. 2.

REPORT OF DR. G. W. ELLIOTT.

746 ST. NICHOLAS AVE.,

NEW YORK CITY, N.Y., April 10, 1909.

The Superintendent of Immigration,  
Ottawa.

SIR,—I have the honour to submit the following report for the fiscal year ending March 31, 1909, showing the number of aliens that arrived at this port destined to different parts in the Dominion of Canada, also number of aliens who were rejected for various causes :—

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*Aliens Arriving.*

|                      | 3rd Class. | 2nd Class. |
|----------------------|------------|------------|
| April, 1908.....     | 1,938      | 295        |
| May, 1908.....       | 1,122      | 178        |
| June, 1908.....      | 359        | 141        |
| July, 1908.....      | 259        | 101        |
| August, 1908.....    | 224        | 102        |
| September, 1908..... | 302        | 109        |
| October, 1908.....   | 353        | 98         |
| November, 1908.....  | 277        | 66         |
| December, 1908.....  | 309        | 51         |
| January, 1909.....   | 249        | 85         |
| February, 1909.....  | 361        | 119        |
| March, 1909.....     | 1,101      | 288        |
| Total.....           | 6,854      | 1,633      |
| Grand Total.....     |            | 8,487      |

*Aliens Rejected.*

|                            |     |
|----------------------------|-----|
| Tuberculosis.....          | 3   |
| Lupus.....                 | 1   |
| Trachoma.....              | 19  |
| Favus.....                 | 3   |
| Insane.....                | 2   |
| Imbecile.....              | 1   |
| Syphilis.....              | 1   |
| Psoriasis.....             | 1   |
| Venereal disease.....      | 1   |
| Organic heart disease..... | 3   |
| Cirrhosis of liver.....    | 1   |
| Muscular atrophy.....      | 1   |
| Hernia.....                | 2   |
| Hysteria.....              | 1   |
| Paralysis.....             | 1   |
| Varicose veins.....        | 1   |
| Pregnancy.....             | 1   |
| Illegitimate children..... | 4   |
| Moral turpitude.....       | 5   |
| Criminals.....             | 4   |
| Deformities.....           | 1   |
| Defective vision.....      | 3   |
| Insufficient funds.....    | 60  |
| Physically defective.....  | 1   |
| Accompanying.....          | 10  |
| Total.....                 | 131 |

Your obedient servant,

GEO. W. ELLIOTT,  
*Canadian Government Official.*

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# OPERATIONS IN WESTERN CANADA.

## REPORT OF THE COMMISSIONER OF IMMIGRATION.

DEPARTMENT OF THE INTERIOR,

WINNIPEG, MANITOBA, April 1, 1909.

The Superintendent of Immigration,  
Ottawa.

SIR,—I beg leave to report that during the past year, as in former years, by means of the employment bureau in this office, ably aided by agents at the principal points of importance in Manitoba, Saskatchewan and Alberta, a thorough system of distributing and finding suitable employment for immigrants was successfully conducted; and, although the figures showing the number of those for whom employment was secured indicate a considerable decrease as compared with those of last year, unfilled applications for farm hands were on file at this office during the whole twelve months.

The number of applications received for farm hands was 4,667, of which 3,237 were filled. In addition to these, 328 applications were received for married couples, of which 185 were filled.

During the year large numbers of intending settlers from eastern Canada, the United States, the British isles and continental Europe called at this office in quest of information and advice in order to enable them to secure locations on which to settle; and I have much pleasure in reporting that so successfully and satisfactorily was the work of locating settlers been conducted that no complaints have been received of parties having been directed to undesirable locations. In this connection I would bring to your notice the valuable aid which the department has received, not only from agents of Dominion lands, immigration agents, sub-land agents and other officers of the department, but also from the secretaries of many boards of trade throughout the west and also from private individuals.

Homesteads well adapted for mixed farming can be secured in Manitoba, Saskatchewan and Alberta within reasonable distances of existing railways, and I would draw the attention of intending settlers to the Winnipeg and Dauphin districts in Manitoba, and especially that part of the latter which embraces the Swan River valley. There is still a number of homesteads to be secured in the Yorkton district, and I am informed by the land agent at Humboldt that there are large numbers of good homesteads in that district—both north and south of the Canadian Northern Railway—to which the attention of incoming settlers should be directed. With the exception of a number of homesteads in the western part of the Estevan district, the districts before mentioned are the most easterly which afford a large selection of homesteads to choose from. There are still 90,000 vacant homesteads in the Moosejaw, Battleford and Prince Albert districts in Saskatchewan, and 70,000 vacant homesteads in the Lethbridge, Calgary, Red Deer and Edmonton districts in Alberta. It will therefore be seen that, no matter what district in the three western provinces an intending settler decides to locate in, he will have no difficulty in securing suitable land.

*English.*—During the past year the immigrants from England were the best class that has ever come to the country; and I consider that this is due, in a great degree, to the restrictive measures which were adopted by the department in regulating the emigration work of charitable institutions in Great Britain.

*Welsh.*—It is to be regretted that only a comparatively small number of Welsh agricultural labourers came to this country during the year.

*Scotch.*—Scotch immigrants during the year were mostly of the agricultural class, and no difficulty was experienced in getting them farm work on their arrival.

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*Irish.*—The immigrants from Ireland were mostly of the agricultural class, and I have again to express my regret that a larger number of these people cannot be secured for Canada.

The number of immigrants from continental Europe shows a considerable falling off as compared with last year. Those who came belonged mostly to the agricultural class, and went on the land.

Settlers from the United States came into the country in large numbers during the year. About 95 per cent of them either entered for homesteads or purchased land. The others went to work on farms. In this connection it is gratifying to note also the immense volume of wealth in the shape of money, stock, machinery, implements and household effects which these people have brought into the country.

I take pleasure in drawing your attention to the fact that the requests made by immigrants for assistance in the shape of provisions, clothes and fuel show a marked decrease as compared with former years.

#### *Immigration Accommodation, Winnipeg.*

Thirty-eight thousand nine hundred and eighty-eight days accommodation was given to immigrants in Buildings Nos. 1 and 2 during the year.

#### *Immigrant Hospital.*

This building was closed on February 1 last, its services not being required for the present.

#### *New Immigration Halls, &c.*

During the year immigration halls were erected at Wainwright and Yonkers; temporary buildings at Mortlach, Herbert and Gull Lake, and premises were leased at Vegreville, Sedgwick and Irvine for the accommodation of incoming settlers.

#### *Correspondence.*

During the year there were sent from this office 2,492 registered and 29,095 unregistered letters. The number of letters received was 22,952.

#### *Exhibits.*

During the year 789 cases of agricultural exhibits were sent to the agents in the United States, Great Britain and British colonies, besides 297 samples of grain to public schools in the United States.

#### *Deportations.*

There were 257 undesirable immigrants deported during the year.

#### *Annual Reports.*

Annual Reports have been received from officers and agents stationed at Port Arthur and Fort Frances, Ontario; Emerson, Brandon, Teulon, Dauphin and Swan River, Manitoba; Regina, Yorkton, Humboldt, Prince Albert, Saskatoon, Battleford, North Portal, Maple Creek, Lloydminster, Duck Lake, Craik, Sinnott and Gravelburg, Saskatchewan; Edmonton, Calgary, Lethbridge, Medicine Hat, Strathcona, Red Deer and Sedgwick, Alberta, and New Westminster and Kingsgate, British Columbia. Many of these reports give information which is of much value in directing incoming settlers to desirable locations, and all give valuable statistical information.

I have again pleasure in saying that much of the success that has attended the work of this branch of the department is in no small measure due to the faithful and conscientious services of the officials in this office and at outside points.

Your obedient servant,

J. BRUCE WALKER,

*Commissioner of Immigration.*

# JUVENILE IMMIGRATION.

REPORT OF G. BOGUE SMART, CHIEF INSPECTOR OF BRITISH IMMIGRANT CHILDREN AND RECEIVING HOMES.

DEPARTMENT OF THE INTERIOR,

OTTAWA, March 31, 1909.

The Superintendent of Immigration,  
Ottawa.

SIR,—I have the honour to submit my tenth annual report as Chief Inspector of British Immigrant Children and Receiving and Distributing Homes.

A year of strenuous activity has been maintained and the work of this branch of the department has been conducted with due appreciation of the responsibility involved therein.

Statement showing progress of the work of inspection during the year 1908.

|                |     |
|----------------|-----|
| January.....   | 103 |
| February.....  | 122 |
| March.....     | 187 |
| April.....     | 206 |
| May.....       | 174 |
| June.....      | 190 |
| July.....      | 208 |
| August.....    | 106 |
| September..... | 160 |
| October.....   | 152 |
| November.....  | 142 |
| December.....  | 71  |

Total..... 1,821

Individual inspections of new arrivals before being placed in situations, not included in above statement..... 192

Grand Total..... 2,013

The probation in the 'Home' before leaving England is most valuable as, apart from the benefits accruing to the children, it enables the societies to weed out those who are not likely to 'make good' in Canada. The demand for juvenile immigrants in the country districts of Canada is well indicated by the following statement which shows the number of children emigrated to Canada during the fiscal year by some of the principal societies, and the number of applications received for children during the same period :—

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| Society or Agency.  | Children Emigrated. | Applications received for Children. |
|---|---------------------|-------------------------------------|
| Dr. Barnardo's Homes, Toronto and Peterboro', Ontario, and Winnipeg, Manitoba | 1,034               | 9,942                               |
| Miss Macpherson, Stratford  | 175                 | 724                                 |
| Mr. J. W. G. Fegan, Toronto   | 75                  | *500                                |
| Rev. Dr. A. E. Gregory, Hamilton  | 90                  | 515                                 |
| Rev. Robert Wallace, 'Marchmont Home,' Belleville                             | 38                  | 513                                 |
| 'Fairknowe' Home, (Mr. Quarrier's,) Brockville                                | 173                 | 723                                 |
| The Misses Smyly, Hespeler  | 22                  | 103                                 |
| Mrs. Birt, Knowlton   | 142                 | 770                                 |
| The Catholic Emigration Association   | 308                 | 638                                 |
| Church of England Waifs' and Strays' Society, Sherbrooke                      | 64                  | 104                                 |
| Church of England Waifs' and Strays' Society, Niagara-on-the-Lake             | 59                  | 410                                 |
| Bristol Emigration Society  |                     |                                     |
| Mr. Middlemore, Halifax   | 152                 | *300                                |
| Salvation Army Emigration Agency  | 42                  | *130                                |
| Mrs. Wallis, Toronto  | 13                  | 45                                  |
| Mrs. Close, Nanwigewank, N.B.   |                     |                                     |
| Women's National Immigration Society, Montreal                                |                     |                                     |
| The Children's Aid Society of London, England                                 | 24                  | +                                   |
| Self-Help Emigration Society  | 13                  | +                                   |
|   | 2,424               | 15,417                              |

Mr. Bruce Walker, commissioner of immigration, has stated that he could place twenty-five British immigrant boys per month, from March to October, in the western provinces of the Dominion.

Table showing the number of juvenile immigrants who arrived in Canada during the past eight years, together with the number of applications received by the various agencies during the same period:—

| Fiscal Year.      | Children Immigrated. | Applications Received. |
|-------------------|----------------------|------------------------|
| 1900-1            | 977                  | 5,783                  |
| 1901-2            | 1,540                | 8,587                  |
| 1902-3            | 1,979                | 14,219                 |
| 1903-4            | 2,212                | 16,573                 |
| 1904-5            | 2,814                | 17,833                 |
| 1905-6            | 3,258                | 19,374                 |
| 1906-7 (9 months) | 1,455                | 15,800                 |
| 1907-8            | 2,375                | 17,239                 |
| Total             | 16,610               | 115,408                |

During my tenure of office I have personally inspected many hundreds of these child-immigrants whilst they were engaged in doing their share of domestic and farm work in various parts of our Dominion, and having listened to the testimony of employers I feel quite justified in reporting that many of the farmers of this country consider the services of the 'Home Child' indispensable.

In passing I should like to say that the designation 'Home boy' or 'Home girl' is perhaps open to misconstruction. It is applied for convenience to immigrant children who have been trained in philanthropic homes or schools in Great Britain, before, and as a preparation for their emigration to Canada, and who are usually taken into the family circle of their employers in this country. The name 'hired boy' or 'hired girl' is often used to describe the same class and is perhaps more appropriate.

On April 1 the Children's Act of 1908 will come into operation throughout Great Britain and Ireland.

\* Estimated. † Not reported.



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This enactment is, in my estimation, one of the wisest and most important and valuable measures of recent times. It teems with provisions for the better treatment of the young, their training and education, and declares in effect that every British child has an inalienable right to good food, clothes and a chance to become a useful citizen. It further recognizes the fact that numbers of young children in the old land are so unhappily surrounded as to be deprived of these rights. This legislation will have an important bearing on what is generally conceded to be the finishing touch of the work of juvenile reclamation, namely, emigration.

The transplantation of poor, unoffending children from the motherland to our shores is promoted and carried on by responsible and competent associations of persons—philanthropists in the truest sense—persons prominent in the religious and social world on both sides of the Atlantic, their work being regarded with ever increasing popular favour.

The opinion of Sir John Kirk, of London, one of the most eminent authorities of the day on philanthropic and charitable work and whom it was my great privilege to meet during my visit to the old land last summer, is expressed thus in a recent letter to the *London Daily Post*: 'As an advocate of emigration and as one who has seen the benefits arising from the presence of English children in Canada, I endorse what the commission says on the subject. I would urge the necessity of sending the children over to Canada as soon as possible, because the sooner they get into the Canadian atmosphere the better it is for Canada and for them.' I feel myself the strength of this view. The emigration of juveniles should certainly be effected at as early an age as it is possible to secure situations and foster homes for them in Canada. It is important to remark that it is only under very exceptional circumstances that children whose parents are both living are emigrated by organized agencies and societies. The children to be emigrated are taken in hand at a very early age, and a training along religious and secular lines is immediately begun. During their tutelage they must prove themselves to be worthy before the responsibility of their emigration is assumed. The length of residence in the training homes is not limited but is made to suit each case. A large majority of the children under my supervision have spent the major portion of their lives under the training and influence of the home.

During my visit to Great Britain I had the pleasure of meeting the Right Honourable John Burns, president of the local government board, and in the short interview I had with him he expressed satisfaction with the manner in which the children were looked after in Canada, and said that he believed the emigration of children at the impressionable age could not result otherwise than beneficially.

Four years ago I visited Great Britain and Ireland with the purpose of familiarizing myself with the conditions of pauper and destitute children, both before being received into institutions of a reclamatory character and after their reception, and at that time found much to commend in the work of the various agencies. On my second visit during the summer of 1908 I found that remarkable progress had been made during the intervening period, and it was most gratifying to observe a more cheerful and promising outlook than had hitherto existed for the future of the nation's needy and ill-cared for children.

To the people of Canada this is important, as for well nigh half a century there has been annually transplanted to our shores a large emigration from the British isles, amounting it is estimated to an aggregate of nearly sixty thousand juveniles.

The emigration of children has always been a voluntary work as far as it concerns the government of Canada, and, from my point of view, must so continue in order to be successful. No propaganda is, therefore, promoted on behalf of the federal government for the emigration of juveniles. The movement can only be consistently carried on through charitable and religious organizations who undertake it voluntarily.

Sir John Kirk has said: 'Before Queen Victoria ascended the Throne there was not a single measure for the saving of the children; when Her reign closed there were over one hundred.'

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The state has in fact awakened to its responsibility in the matter, and to the national and economic importance of the children of the neglected class, and is actively co-operating with the private and voluntary agencies operating so successfully in their behalf.

While paying visits to these agencies and surveying the wide field of their efforts, I have been made aware of great and unceasing devotion to the cause on the part of persons in various walks of life, and I confess that, as a British subject I have experienced a feeling of pride in the Christian and benevolent attitude of so many of the people of Great Britain in this behalf.

But, notwithstanding the great work that has been accomplished, a survey of the field irresistibly forces one to admit that the result, after all, amounts merely to a drop in the ocean. The necessity for continued effort is patent to any one who pays a visit to the thickly populated and pauperised districts of the old world. But this is evidently well understood over there.

While one must with sadness acknowledge that there is always a class which is, humanly speaking, beyond the hope of rehabilitation in the social scale, it has been most completely demonstrated that there is another class, or one might say another stage in the development of the hapless class for which there is great hope. The juvenile on the verge of the moral precipice may be saved to a life of usefulness and integrity. His loss is the nation's loss, his well-being the nation's gain. But they must be helped to rise and systematically helped.

During my recent visit to England and Scotland I spent a great part of many days and nights in the congested districts of the large cities, and witnessed sights that not only filled me with sadness but with shame for our common humanity. Hundreds and thousands of young children, half-clad, half-fed and wholly untaught in anything that would make for their future happiness or well-being roam these crowded streets, by night as by day. While it is not the wisest policy to relieve the parents of their responsibility towards their children and such action should as far as possible be avoided, yet there is the well-being of the child to be considered and the state also stands in a position of responsibility towards the child which may, and often must; necessitate the removal of such children to environments morally and physically more wholesome.

It has been estimated, and some say conservatively, that there are 250,000 needy children under the age of 18 in Great Britain and Ireland. Of this large army, 25,000 are in industrial and other schools under the Home Office, and 69,000 are under the care of guardians of the poor in scattered village homes. In addition to this census there should be included the fluctuating number dealt with by the Ragged School Union, the Barnardo and other voluntary and private agencies, not overlooking the children who are suffering from want of any supervision whatever. These agencies, I have referred to, are doing a work that cannot at present be fully estimated and the highwater mark in this branch of philanthropy has, I believe, been attained. While a cause such as this necessarily makes demands of magnitude on the state exchequer and on private charity, it is far above all monetary consideration and cannot fail to return to the nation more than is expended. The children require individual attention and moral training far more than they do mental training; at the same time I do not wish to under-estimate the latter.

It was my good fortune to meet in convention at Manchester workers from various parts of the Kingdom. This gathering, which is held triennially, was one of deep interest and most instructive. Those who participated in the deliberation were zealous and enthusiastic and the addresses were remarkably interesting and helpful to one who has the interests of the necessitous juvenile at heart. The audiences were large, thus evincing the keen interest taken in the work of child rescue. It occurred to me, however, if I might be permitted to offer a suggestion, that the scope of the conference might with advantage be enlarged so as to include representatives of the Poor Law

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and voluntary organizations, whose aims and labours are identified with those of the reformatory and refuge unions.

One very interesting feature of the convention was the opportunity afforded of visiting the schools and homes within convenient distances of Manchester. Among these were the industrial and other schools under the Home Office. These industrial schools differ from the industrial schools of Canada which are always semi-penal institutions.

In the English industrial schools useful trades are efficiently taught, and music and gymnastic exercises form, very properly, a feature of the school life. Where children are, necessarily, brought up under strict discipline, and in narrow confines, as I found to be the case in many industrial schools in the cities, such pastimes are essential to their health and physique. The buildings are planned to economize space, yet the interior appeared to me to be up to date and conducive to comfort. In only one school did I feel that the arrangements, in case of fire or other danger, might have been better. The children are not required to wear any uniform or distinguishing badge, but were rather better clad and cleaner than those of the same class outside. The food was good and wholesome and the healthy appearance of the children gave evidence of the care bestowed on them.

The officials impressed me as very capable and as possessing that necessary force of character required for those in their position.

A special visit was paid to the Nile street (Liverpool) Day Industrial School, which differs from other schools mentioned in that it is practically a public elementary school; the children living at home and attending as day pupils. This school is modern and splendidly equipped and must be a great boon to the poor children of that great seaport city. The refining influence of this institution on the children was very marked. What a blessing these schools are! This was impressed on me as I gazed upon the crowds of ill-fed, ragged children who were lined-up opposite this school, drawn there by curiosity at seeing the members of the conference enter the school. There were nearly 100 juveniles and adults in the crowd and one was able to contrast their condition with that of their more fortunate brothers enrolled in the school.

In company with Mr. Courtenay Lord, J.P., of Birmingham, I had the privilege of attending, and being honoured by a seat on the bench, at a sitting of the juvenile court, which, by the way, is the original juvenile court of Great Britain. The first children's court in England was organized in 1905, and, like similar institutions in the United States very soon demonstrated its usefulness. As constituted, there are three magistrates who deliberate collectively and I was pleased to find an entire absence of that judicial atmosphere which, as a rule, pervades police courts. The offenders, or delinquents as they are designated, are summoned for gambling, tossing pennies constituting that charge, vagrancy, sleeping out, being found under prejudicial guardianship, and more serious misdeeds, such as theft in its various degrees. When brought into the court room, the children are spoken to with kindness and tact and given to understand that they are amongst friends and have nothing to fear. I had not been in the court room many minutes before it was apparent to me that the magistrates on the bench were gentlemen, chosen on account of their sympathy with, and desire to help unfortunate children.

The officials of this model court do all that they can to prevent a conviction being recorded against a young person who, in their opinion, is not competent to know what is right and what is wrong. Such a one has never been taught what constitutes good conduct, does not know how to act without committing offence. This coincides with my long formed and deep-rooted opinion that no child under the age of 12 years should be considered competent to answer in court for any transgression, as at such an age its character is still in a plastic condition and is not sufficiently formed to bring it within the range of individual responsibility. In the Birmingham court there is neither undue haste nor formality in the proceedings, the magistrates are most patient with the children and their parents, who are required in nearly every case to accom-

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pany their child to the court. Since this more humane mode of dealing with youthful offenders was adopted, a remarkable reduction has taken place in the number of children committed to prisons, as the following table indicates :—

|                                       |     |
|---------------------------------------|-----|
| 1904 (committed from Birmingham)..... | 112 |
| 1905 “ .....                          | 33  |
| 1906 “ .....                          | 9   |
| 1907 “ .....                          | 0   |

It is reasonable to anticipate that with the adoption of juvenile courts in Canada similar results will follow.

Unless a child is convicted of a very serious crime, and possesses a bad record, it is not sent to prison, but allowed to go on probation for a definite period of supervision under voluntary workers, some of whom are young men of means and university graduates. They report *viva voce*, at each sitting of the court, as to the behaviour, school attendance, &c., of the children individually.

Industrial schools are for the reception of children under 14 who have been found begging, wandering, homeless, &c.

One of the striking features of British justice in relation to the work of reclaiming poor and needy children is that parental rights are, as far as possible, maintained. When children are committed to industrial schools, an order is made by the court requiring the payment by the parent of a nominal amount towards the maintenance of the child in the school. Many, in fact, it may be said the majority of parents, are so impoverished that they are unable to make this small contribution, and in such cases no effort is made to enforce the order.

In addition to the institutions to which I have referred, there are those schools under the supervision of the boards of guardians, which are known as poor law schools, and are conducted under the supervision of the local government board of London.

The children admitted to these excellent training homes are of the orphaned and destitute classes and are there, not from any fault of their own but purely through misfortune. The old morally dangerous system of placing children of the impressionable age in workhouses is being abandoned. Under the guardians, children are placed in cottage homes or boarded out, instead of being housed in large buildings, and are under the supervision of carefully selected foster parents. These Homes are not only distinct from the workhouse, but in many cases are situated in rural districts. An efficient government inspection is maintained and the health of the children receives careful attention. The school curriculum is much the same as that of the public elementary schools.

Another important branch of the work of uplifting needy children is that of the voluntary and private homes and schools. In no other branch of philanthropy is there more beneficial work being carried on. No needy and deserving child is ever turned away from their doors. Agents and voluntary workers are ever at work, searching through the bespattered fringes of British civilization and seeking out cases of unbenefriended and forlorn juveniles.

Mr. Thomas R. Ackroyd, of Manchester, has fittingly defined the character of the work of the societies in the following well chosen words :—

‘We constrain ourselves to look steadily for our own heartening at the primary object of the work to take the child in all its distress and helplessness from surroundings of misery and degradation, and place it under conditions where it may have a normal chance of a happy child life, and the prospect of growing up to be an honest, industrious and respected member of the community.’

After an arduous career of many years of patient work in the cause of social reform these agencies have had the gratification of seeing their labours rewarded in a degree far beyond their most sanguine expectations.

In the larger cities of England I observed that the policeman is a real friend of the ragged and neglected juvenile and co-operates with the various agencies engaged

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in rescue work. Many a homeless wanderer is stopped at night by the policeman's friendly hand. I have on many occasions seen a policeman late at night leading by the hand a poor, ragged, derelict child of from 10 to 12 years, and endeavouring to locate his home. In London, and in that great seaport, Liverpool, the relation of the police to the child, was much impressed upon me. In his admirable paper, on 'The Police and the Child,' read at the Manchester Conference, Mr. Dunning, head constable of Liverpool, stated:—

'We hope, not without reason, I think, that the child who, in the fright of being lost in the street, has found a friendly hand in that of a policeman, that the child who has to thank a policeman for getting him the first, perhaps the only decent suit of clothes he ever had, that the child whose possession of a trading belt has brought him into relations of intimacy with the police, will as he grows up be more inclined to look upon a policeman as his friend rather than as his enemy and to realize that the law personified in the policeman is something to be respected as a protection to himself rather than as something to be hated and feared as a means of oppression and punishment.'

One of the most admirable features of the work of helping needy children is that exemplified by the system now in operation at Liverpool.

When a policeman finds a poorly clad child in the street special inquiry is made by the officer into the child's home, and it is ascertained whether the parents are in a position to clothe the child properly. The police committee decide if a case be deserving of the attention of the Police Aid Clothing Association, and, if so, the boy, or girl, is supplied with a complete outfit of good, substantial clothing, is granted a special license to sell papers, matches and other articles in the streets and is known as a 'Street Trader.' No child under eleven is allowed to trade in the streets, it being recognized that the street is the worst place for the child.

The license reads as follows:—

YOU MUST NOT SELL ANYTHING IN THE STREETS ON SUNDAYS.

CITY OF LIVERPOOL.

Child Trading License No. ....

I certify that, . . . . . of, . . . . . is licensed by the Watch Committee to trade in the streets of the City, under the provisions of the Liverpool Corporation Act, 1902, section 50.

Description of child: Sex..... Age..... Years..... Height: feet..... inches..... Complexion..... Eyes..... Hair..... Figure..... Marks.....

Certified this.....day of.....190 .

(Facsimile signature.)  
(Facsimile signature)  
LEONARD DUNNING,  
Head Constable.

0 407 L.P.S. Co., 11/7 Est. 3,S13.

This certificate will expire on the 31st day of December, 190 .

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A special belt, bearing the consecutive number of the license, is worn and the street trader is then permitted to engage in business. It is stipulated that, if possible, the juvenile trader shall repay a nominal amount of the cost of the clothing supplied and it is manifest that this wise system tends to inculcate habits of thrift and industry in this class of children. It prevents their feeling that they are beggars dependent on the charity of the municipality.

The Ragged Schools' Union of London, the pioneer of philanthropic enterprises, is one of the greatest influences at work for the benefit of humanity in general, and needy childhood in particular in Great Britain. For upwards of 64 years its workers have freely and enthusiastically given their time and have met with an abundant measure of success. The scope of their work includes 285 Sunday schools, with 44,502 scholars, and 4,721 teachers, and 219 bible classes, having 5,334 members; 69 industrial classes attended by 3,029 boys and girls; 116 bands of hope, with 1,962 members.

During the present year the London County Council are expending a considerable amount of money for the purchase of cooking utensils, for the various schools in London where meals are provided for needy children.

Under an Act for the feeding of necessitous school children, those who cannot procure food, have the right to make a demand on the state for relief in their necessity.

In conclusion, let me say that the admirable efforts now being made in Great Britain for the removal of this great stumbling-block from the paths of national and moral progress cannot be over-estimated, and the growing spirit of interest and enthusiasm amongst moral reformers in Great Britain is manifested by such evidences as the admirable 'Children's Bill' previously referred to.

Mr. K. J. Henry's report for the year is as follows:—

'The inspection of British children by me during the past year I found to be much as in previous years—children and employers in the main being satisfactory. Many of those seen before by me showed a marked improvement, not only in growth, dress and knowledge of the farm, but in being more obedient, truthful and inclined to do their part cheerfully and well, attributable largely, I should say, to fair treatment, better sense and the knowledge of shortly being thrown on their own resources. Very many seen will in a few months have reached the age limit and are perfectly competent to look after themselves. Some remain on with their present employers for another year, others in doubt or who have decided to go west take land or work on railways.

'The demand for girls and boys is still as general as in previous years and the desire for fair treatment is even more marked. There are exceptional cases where terms of agreement are not being carried out, whilst in many others they exceed the terms in schooling, clothing and even remuneration. Generally, then, I may say my season's work has been very gratifying.'

Mr. R. W. Hillyard states:—

'Since my last report ample opportunity has been afforded me of becoming more familiar with the interesting work of child emigration to Canada. As my territory comprised a large portion of the provinces of Ontario and Quebec I found myself in touch with children from different homes and agencies. It is my pleasing duty to bear testimony to the general good behaviour and industry of the great majority of those inspected and the satisfactory class of homes selected for them. On inquiry at the public schools where these children attend, the teachers have reported most favourably as to their character and aptitude to learn, in fact some stand first in their forms. Cases have come under my observation emphasizing the importance and value of the work. A youth, now 18, is in receipt of a wage of \$160 and keep for this year. He is a fine looking lad, and employer says "without a stain upon his character." Another boy of 17 took such a deep interest in his work that his employer has purchased a farm for him and will set him up as a farmer. Numbers of these former immigrants I have found in positions of trust and responsibility: some as honoured ministers of churches and others upon their own farms. It is difficult to comprehend the great good accom-

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plished by the various agencies and time is revealing the importance of child immigration to our Dominion.'

Mr. Annand, Inspector for the Maritime Provinces, reports as follows :—

'I have the honour to submit my annual report as assistant inspector for Nova Scotia and New Brunswick of British immigrant children. To what extent it has been accomplished may be examined a little in detail.

'First—As to the value of child immigration to Canada of a desirable class. From closest inspection and investigation of many years' experience mingling with all classes and conditions of immigrants, I have not the slightest hesitation in stating that child immigration, under judicious management, is far more advantageous to the country than the adult immigrant with small capital and without energy and ability to take advantage of the resources of Canada. My contention is that the younger the child the easier for it to assimilate the habits of the people of the country. The child of tender years lives and grows up in the land of his or her adoption, acquiring a knowledge of Canadian farm life and other work, as carried out under present surroundings, whereas the adult has set ideas, which are difficult to remove.

'During my inspection last year I found that most of the immigrant boys had made remarkable progress. It was pleasing to find so many proving themselves suitable for farm life and work in our agricultural districts and the girls adapting themselves to domestic work, which proves that later on they will become good housekeepers.

'I was very much impressed with the carefulness displayed by the management of the distributing homes in placing their children so well. I found in most instances that they were contented and well provided for, and the feeling of satisfaction manifested between child and employer was a splendid indication of the improvement over other years. To my mind child immigration has proved an unqualified success.

'In some cases the children's schooling might be given more attention, although it must be said that in certain localities the school is so remote from the home that during inclement weather it would be a hardship for the children to attend.'

Mr. Thomas Cory, Inspector for the Western Provinces of Canada, says :—

'I beg to report that the children under departmental inspection in the western provinces of Canada have been indentured with a good class of farmers, and that, save in one instance, their employers were well pleased with them.

'After their first year's experience the general policy is to increase their wages, and I found in the majority of cases the boys were in receipt of adequate remuneration for their services. Many under the age of 17 have become quite as efficient in their particular work on the farms as men.

'It is a significant fact that I heard no complaints as to character and behaviour. The children were of good types, and reminded me much of the average English school boy. The value of this branch of immigration cannot be over-estimated. During my itinerary it was almost of daily occurrence to receive applications for this class of farm help.'

## RECEIVING AND DISTRIBUTING HOMES.

Brief reports follow on my inspection of the various receiving and distributing homes during the year. The great importance of these centres cannot be over-estimated, on account of their helpful influence on the children. While not encouraged to retreat to these homes at a mere whim, the children are given to understand that those in charge are their friends and it is to them they may look for advice and counsel when required.

## MR. MIDDLEMORE'S HOME.

*Fairview, Halifax, N.S.*

The superintendent of this home, which I inspected February 19, reports a very satisfactory year's work. There were eight hundred and two children under the protec-

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tion of this agency. During 1905, ninety-five completed their apprenticeships and were allowed to do for themselves. Health reports were good, only one death amongst their number having occurred. An efficient supervision is maintained, the visitors' reports which I examined showing that particular attention is paid to this branch of the work. Three children were at the home to-day, two boys and a girl having recently returned from their former places.

The home is well equipped and is kept in good order.

#### THE NEWCOMERS' INN.

##### *Salvation Army Receiving Home, Toronto, Ontario.*

On January 6, date of my inspection, there were only two boys in residence. The house is splendidly adapted for a receiving and distributing centre, being within easy distance of the railway stations. It is in charge of Salvation Army officers.

The army is gradually increasing its juvenile emigration work. I have personally inspected a number of its wards and have found them doing very well, being, with few exceptions, suitable types for farm work.

#### MRS. BIRT'S DISTRIBUTING HOME.

##### *Knowlton, Quebec.*

On February 25 my annual visit of inspection to this home was paid.

Twelve children, five boys and seven girls, were in residence. A staff of ladies have charge of the work here and perform their duties efficiently. The home was in good order throughout. Of the large number of Mrs. Birt's immigrants inspected during the year, reports show that, with few exceptions, they are well placed and making satisfactory progress.

#### THE GIBB HOME FOR BOYS.

##### *Sherbrooke, Quebec.*

There was one boy at this home February 24. Seventy boys were received and placed in situations during the year. A larger number of applications than usual for boys for farm work were received.

#### SELF-HELP EMIGRATION SOCIETY OF LONDON, ENGLAND.

Thirteen boys were emigrated to the Dominion by this society during the past year. They were sent to situations in the provinces of Ontario and Quebec. Of those inspected by this branch of the service few were not doing well.

#### THE 'COOMBE' HOME,

##### *Hespeler, Ontario.*

I paid my annual visit to this interesting distributing home on January 28. The arrangements for the reception, accommodation and employment of children are excellent. Eleven boys and seven girls were in residence, some temporarily, others changing places and a few attending the Hespeler schools before being placed out. I was greatly struck by their intelligence and well kept appearance. They were all engaged, the girls sewing, sweeping or at other domestic duties and the boys at outdoor work.



## MARCHMONT HOME,

*Reverend Robert Wallace, Belleville, Ontario.*

On January 7 I officially visited Marchmont Home.

Four children only were in residence, two boys and two girls. The system of visiting the children is regularly kept up and their welfare is not in any way, I believe, overlooked. A complete history of each child is recorded.

Mr. Wallace has again found it impossible to supply the applications of the past year for juvenile labour.

## MR. J. W. C. FEGAN'S HOME,

*Toronto, Ontario.*

On April 24 I visited Mr. Fegan's distributing home and as his first party for 1909 had just reached Toronto I was afforded the opportunity of inspecting the children before they had been sent out to their new situations. They were a fine lot, of good physique and intelligence and apparently well selected. A small number only have been removed from their situations during the year. The visitors' reports were most interesting and showed that with few exceptions the boys were doing well and with good farmers and generally in a prosperous condition.

A pleasing feature of the year was the hearty and voluntary manner in which Mr. Fegan's young immigrants contributed towards the expense of emigrating next year's party.

Mr. George Greenway, after a faithful service of many years, has retired and has been succeeded as superintendent by Mr. Richard Render, who had long been identified with Mr. Fegan's work in England.

## DR. BARNARDO'S HOMES.

The Barnardo branch homes of this organization are situated in Toronto, Peterborough and Winnipeg. A very active year's work has been prosecuted by these agencies. During the past twelve months their young immigrants numbered 1,034, and the proposed immigration for the approaching year it is estimated will exceed that of previous years.

The demand for juvenile farm labour from these agencies has been insatiable and the general condition of the children under departmental inspection has been found satisfactory. In dealing with such a large number of children it is obvious that some disappointments and failures should rise to the surface. In this connection it may not be uninteresting to quote the following statement from a recent editorial in *Night and Day*, one of the many publications issued under the auspices of Dr. Barnardo's organization: 'Out of nearly twenty-one thousand young people sent by the home to Canada and the colonies not twenty in a thousand have disappointed our hopes.'

The system of placing out and supervising the children in Canada has contributed in a large measure to the success of the work. A large staff is permanently employed for this purpose and visits are made at least once a year. The children are educated, before leaving England, to the fact that in coming to Canada they are to be placed on farms with the result that few are found in other occupation than farming. A regular correspondence is encouraged and carried on with their wards.

The receiving home at Toronto is well equipped and efficiently managed. The children have comfortable quarters during their stay there. For younger children a private elementary school is provided.

The Margaret Cox Home for Girls, at Peterborough, is the chief point of distribution for girls. The house has recently been enlarged by the addition of a wing, through the munificence of the Honourable Senator Cox, who for many years has

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taken a deep interest in Dr. Barnardo's work. The responsibilities entailed by the management of the home and the supervision of such a large number of girls of various ages are discharged by a competent staff of ladies.

THE CHILDREN'S HOME AND ORPHANAGE,

*Reverend Dr. Gregory, Hamilton, Ontario.*

I personally inspected fifty-four boys at this home, on their arrival from England. In type and intelligence they were a splendid party. Each boy had spent from twenty-one months to five years in their training homes preparatory to emigration. At least twenty of the party left for their places during my visit at the home and all had been allotted places before they actually reached Canada. During the year a large number of their wards have been personally inspected by me in their situations. They were doing well, adequately paid for their services and given good reports by their employers. The home is well arranged and managed.

MISS MACPHERSON'S HOME,

*Stratford, Ontario.*

On January 26 I paid my annual visit to this home. There were four small children in residence. Their visitor's report indicates that the children under supervision are doing well. The record of each child is carefully kept and information concerning their progress readily available. The home throughout is well maintained and the children receive every attention and comfort during their stay at Stratford.

ST. GEORGE'S HOME,

*Catholic Emigration Association, Ottawa.*

On March 31 last there were 1,279 juveniles under the direct supervision of the association, nearly all of whom are to be found on farms.

Fewer children were in residence on the occasion of my visit to the home than one might reasonably expect, a circumstance that speaks well for their suitability and contentment with the situations provided for them.

The home is well arranged and in splendid order throughout. There has been a fair emigration of juveniles to the Dominion during the past year, the total number being 307. Of this number 5 only were returned to England. Four visitors are employed in maintaining a supervision of their wards. The system of an annual visitation is kept up and the welfare of the children is not overlooked.

FAIRKNOWE HOME,

*Brockville, Ont.*

One hundred and seventy-three children from the orphans' homes, Bridge of Weir, Scotland, were placed in situations by this agency during the present fiscal year. They were located chiefly in the eastern counties of Ontario and with few exceptions with farmers.

The superintendent maintains a careful supervision of their wards and their visitors' reports indicated that the children were doing well. The work of this home is held in high esteem by the citizens of Brockville.

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OUR WESTERN HOME,

*Niagara-on-the-Lake, Ontario.*

My annual visit of inspection to this home occurred August 22 and, as on former occasions, I found the home well maintained and children comfortably quartered during their residence. There were a number of little girls in the home at this date, all of whom I inspected. The younger were attending classes in the private school in connection with the home and others were busily engaged sewing and doing other domestic work.

The pleasure was afforded me of meeting Reverend Mr. Rudolf, of London, England, the executive head of the society, with whom I had an opportunity of discussing the work in its various branches.

Your obedient servant,

G. BOGUE SMART,

*Chief Inspector of British Immigrant Children and Receiving Homes.*

## REPORT OF THE CHIEF MEDICAL OFFICER.

OTTAWA, March 31, 1909.

W. W. CORY, Esq.,

Deputy Minister of the Interior,  
Ottawa.

SIR,—I beg to submit my sixth annual report as chief medical officer of the medical inspection of immigrants carried on during the year ending March 31, 1909.

The work has not notably increased in extent during the past year, except in so far as it has been more searching and exact.

The development of the coastwise trade between British Columbia ports and the neighbouring cities of Puget Sound, in the United States, is becoming so rapid, and the influx of immigrants for employment at railway construction, lumbering and mining, so great that it is making the inspection work, both civil and medical at the coast of increasing importance and difficulty. The many avenues of ingress between the Crowsnest Pass and Puget Sound, where only an imaginary line intervenes, create a situation regarding which it is difficult to determine just what the best interests of Canada from the medical standpoint demand. Other questions both moral and social are intimately associated with the physical health of a class of immigrants who have been essentially drifters from one mining camp to another or one railway camp to another in the United States. As the class of labour supplied by them is there constantly in demand, it would appear that, until supplied from elsewhere, the situation requires that through inspection the unfit and undesirable should be weeded out. This is done in part by inspecting officers being placed at Sumas, Blaine and Seattle, inspecting for civil cases, while any physical defects are reported for further examination to the medical officer at Vancouver.

Inspection is carried on with ever increasing care at Atlantic coast ports, the many requirements before sailing serving as well to keep from taking passage immigrants of inferior type physically. In addition, however, to this further measures are being constantly adopted for making the medical supervision by the medical officer, during the voyage, more constant and exact. The bill of health required to be signed by him was printed in last year's report, wherein he is required to state in detail the cases of disease which have come under his observation during the voyage and to sign the report

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to the effect that such are all that occurred during the voyage. This has been followed up by this year's circular which requires a signed statement that the medical officer has made a yet closer and more detailed examination :—

‘ CANADIAN IMMIGRATION SERVICE.

‘ *Ship Surgeon's List for Medical Examining Officer.*

‘ This is to certify that I am the ship's surgeon of the SS.....of the.....SS. line, and that I have daily during the present passage made a general inspection of the passengers on this vessel, and that I have, at least, once during the passage made a detailed individual examination of each immigrant on board, and that I have seen no passenger thereon who, I have reason to believe, is, or is likely to become insane, epileptic or consumptive, or who is idiotic, feeble-minded or afflicted with a contagious, infectious or loathsome disease, or who is deaf, dumb or blind, or otherwise physically defective or whose present appearance would lead me to believe that he or she might be debarred from entering Canada under the Immigration Act, with the exception of the.....persons enumerated below; and that no births or deaths occurred during the passage with the exception of those mentioned underneath.’

(*List follows here.*)

To make the requirements of this circular yet more effective the medical superintendent of the immigration hospital of a seaport is required to notify the head office of the steamship company in the following terms of cases which have been overlooked by the medical officer of the vessel :—

‘ Port of.....

‘ SIR,—I beg to inform you that on the SS.....which arrived here on the .....day of.....there were detained the immigrants mentioned underneath for reasons stated opposite their names. Of this number those whose names are underlined were cases which with proper care should have been reported by your ship's surgeon on “list for medical examining officer,” but which were not so reported, and I bring the matter to your attention for such action as you deem advisable.

‘ Name      Age.      Manifest.      Page.      Line.      Reason for Detention.’

In this way the steamship company is advised as to the neglect of one of its officers, and ought not to complain, if, after notification and no action is taken to correct the neglect, the medical inspection of their vessel should thereafter take more time on arrival in port.

To illustrate, the following notes are taken from the report of the medical officer at Quebec, on three different ships arriving on the same day :—Detained at hospital, general observation, 1; high temperature, 2; observation of eyesight, 1; mental observation, 2; suspected trachoma, 1; feeble-minded, 1; observation of scalp, 1; suspected epilepsy, 1; observation of eyes. 4.

It will be recalled that, as illustrated by the form printed in last year's report, these requirements of the medical officers are preceded by a signed statement made by the immigrant on purchasing a ticket that he has given correct answers as to his civil status, and in the case of assisted immigrants, accompanied with a complete report to be filled out by a registered practitioner in the country where the emigrant takes passage. When to these really complete precautions, every immigrant is subjected to a thorough observation by a trained medical officer at the port of landing, it must again be insisted upon as was stated in the report for 1907-8 :

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'When in addition to these various measures taken to sift out undesirable immigrants the examination of each person in succession is made by one, and at the large seaports by two medical officers, followed by a thorough civil examination or inquiry into their age, occupation, destination, financial standing and an estimate of their moral qualities and likelihood to succeed in Canada and become good citizens, it would appear that little more could reasonably be done to prevent the ingress of improper persons to the country.'

That the precautions taken to prevent physically undesirable persons from taking refuge in Canada do not cease at the port of landing is seen from the requirements of sections 28 and 33 of the Immigration Act 1906 making it the duty of all clerks of municipalities to report to the Minister of the Interior any cases of insanity, crime or pauperism in immigrants occurring within two years of their landing in Canada.

How effective the operations of these provisions has been is seen in the detail set forth in Table IX. giving particulars of the deportations in 1908-9.

TABLE I.—STATEMENT showing the Total Number of Vessels Carrying Immigrants Arriving at the Ports of Quebec, Halifax, St. John, North Sydney, Vancouver and Victoria, during the Fiscal Year 1908-9.

| Port.             | April. | May. | June. | July. | August. | September. | October. | November. | December. | January. | February. | March. | Totals |
|-------------------|--------|------|-------|-------|---------|------------|----------|-----------|-----------|----------|-----------|--------|--------|
| Quebec.....       | 4      | 28   | 28    | 30    | 27      | 29         | 24       | 15        | ...       | ...      | ...       | ...    | 185    |
| Halifax.....      | 20     | 21   | 9     | 7     | 5       | 12         | 4        | 6         | 14        | 13       | 14        | 18     | 120    |
| St. John.....     | 11     | 12   | 12    | 3     | 3       | 3          | 3        | 4         | 9         | 12       | 8         | 12     | 72     |
| North Sydney..... | 10     | 18   | 16    | 15    | 16      | 17         | 17       | 15        | 18        | 12       | 11        | 13     | 174    |
| Vancouver.....    | 2      | 3    | 4     | 5     | 3       | 4          | 3        | 3         | 3         | 3        | 3         | 4      | 39     |
| Victoria.....     | 8      | 6    | 6     | 11    | 7       | 7          | 5        | 7         | 7         | 7        | 5         | 6      | 82     |
| Totals.....       | 55     | 64   | 65    | 72    | 61      | 62         | 56       | 50        | 51        | 47       | 36        | 53     | 672    |

As compared with 1907-8 there was a less number by 63 of vessels bringing immigrants to Canada, but that the companies lessened so slightly the number of sailings even though the immigrants by seaports were 87,076 as compared with 204,157 in 1907-8, indicates the conviction that the falling off was but temporary.

TABLE II.—STATEMENT showing the Number of Immigrants Detained and the Number Debarred at Ports since December, 1902 when Medical Inspection was first begun.

| Port.             | Fiscal Year 1902-3 |       | Fiscal Year 1903-4. |       | Fiscal Year 1904-5. |       | Fiscal Year 1905-6. |       | Fractional Fiscal Year (9 months) 1906-7. |       | Fiscal Year 1907-8. |       | Fiscal Year 1908-9. |       | Totals. |       |
|-------------------|--------------------|-------|---------------------|-------|---------------------|-------|---------------------|-------|---|-------|---------------------|-------|---------------------|-------|---------|-------|
|                   | Det'd.             | Deb'd | Det'd.              | Deb'd | Det'd.              | Deb'd | Det'd.              | Deb'd | Det'd.                                    | Deb'd | Det'd.              | Deb'd | Det'd.              | Deb'd | Det'd.  | Deb'd |
| Quebec.....       | 15                 | 15    | 817                 | 179   | 1,422               | 454   | 1,163               | 320   | 523                                       | 117   | 873                 | 278   | 1,835               | 251   | 6,648   | 1,614 |
| Halifax.....      | 124                | 124   | 705                 | 27    | 449                 | 36    | 366                 | 10    | 392                                       | 7     | 730                 | 274   | 572                 | 39    | 3,338   | 517   |
| St. John.....     | 134                | 134   | 313                 | 68    | 145                 | 6     | 396                 | 32    | 113                                       | 13    | 296                 | 46    | 502                 | 43    | 1,899   | 342   |
| Montreal.....     | .....              | ..... | .....               | ..... | 146                 | 2     | 137                 | ...   | 208                                       | 11    | 589                 | 9     | 165                 | 10    | 1,245   | 32    |
| North Sydney..... | .....              | ..... | .....               | ..... | .....               | ..... | .....               | ..... | .....                                     | ..... | 4                   | 4     | 4                   | 4     | 8       | 8     |
| Vancouver.....    | .....              | ..... | .....               | ..... | .....               | ..... | .....               | ..... | .....                                     | ..... | .....               | ..... | .....               | ..... | .....   | ..... |
| and Victoria..... | .....              | ..... | .....               | ..... | 397                 | 113   | 1,456               | 118   | 2,257                                     | 242   | 2,040               | 455   | 335                 | 31    | 6,485   | 959   |
| New York.....     | .....              | ..... | .....               | ..... | .....               | ..... | 52                  | 44    | 50  | 50    | 106                 | 106   | 131                 | 131   | 339     | 331   |
| Totals.....       | 273                | 273   | 1,835               | 274   | 2,559               | 611   | 3,570               | 524   | 3,543                                     | 440   | 4,638               | 1,172 | 3,544               | 509   | 19,962  | 3,803 |

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An analysis of the above table is of much interest, and can only be understood by a reference to conditions prevailing in different years. Thus in 1902-3 only a few persons were detained as there was no detention hospital, and the 273 were kept on board ship and returned. In 1903-4 medical inspection was carried on, but the detention hospital was temporary and managed by the steamship companies, except for May and June in 1904. Since then the hospitals have been erected and controlled by the medical officers of the department, but as the hospitals are the only places arranged for compulsory detention of immigrants from any cause, it has occurred that during the year 1908-9 a notable number of detentions have been for causes other than medical, chiefly indeed for lack of funds. Hence the anomaly is explained of how in 1907-8 there were only 4,638 detained and 1,172 debarred, while in 1908-9 there were 3,544 detained but only 509 debarred, the matter of funds having been arranged by friends in Canada.

Remembering that but 87,076 immigrants arrived in Canada via seaports as compared with 204,157 in 1907-8, the increasing strictness of inspection which detained more than five-sevenths as many and debarred nearly half as many may be fairly estimated.

TABLE III.—STATEMENT for the Ports of Halifax, St. John and Quebec, showing the Number of Immigrants Detained and Debarred during the Fiscal Year 1908-9.

| SS. Line.               | Port.         | Number Examined. | Detained. |         | Debarred. | Ratio of detained to Number examined. | Ratio of debarred to Number examined. |
|-------------------------|---------------|------------------|-----------|---------|-----------|---------------------------------------|---------------------------------------|
|                         |               |                  | Males.    | Females |           |                                       |                                       |
| Allan SS. Line.....     | Halifax.....  | 14,124           | 183       | 112     | 19        | 1 in 48                               | 1 in 743                              |
| " ".....                | St. John..... | 28,413           | 316       | 180     | 105       | 1 in 57                               | 1 in 270                              |
| " ".....                | Quebec.....   | 42,537           | 499       | 292     | 124       | 1 in 54                               | 1 in 343                              |
|                         | Totals.....   |                  |           |         |           |                                       |                                       |
| C. P. R. SS. Line.....  | Halifax.....  | 130              |           |         |           |                                       |                                       |
| " ".....                | St. John..... | 19,261           | 261       | 228     | 43        | 1 in 39                               | 1 in 448                              |
| " ".....                | Quebec.....   | 23,792           | 778       | 205     | 62        | 1 in 24                               | 1 in 384                              |
|                         | Totals.....   | 43,183           | 1,039     | 433     | 105       | 1 in 29                               | 1 in 411                              |
| Dominion SS. Line.....  | Halifax.....  | 2,312            | 20        | 14      | 5         | 1 in 68                               | 1 in 462                              |
| " ".....                | Quebec.....   | 9,875            | 172       | 127     | 54        | 1 in 33                               | 1 in 183                              |
|                         | Totals.....   | 12,187           | 192       | 141     | 59        | 1 in 36                               | 1 in 206                              |
| Donaldson SS. Line..... | St. John..... | 676              | 12        | 1       |           | 1 in 52                               |                                       |
| " ".....                | Quebec.....   | 2,370            | 22        | 12      | 16        | 1 in 70                               | 1 in 148                              |
|                         | Totals.....   | 3,046            | 34        | 13      | 16        | 1 in 65                               | 1 in 190                              |
| Other Lines.....        | Halifax.....  | 3,133            | 175       | 68      | 15        | 1 in 13                               | 1 in 209                              |
| " ".....                | St. John..... | 252              |           |         |           |                                       |                                       |
| " ".....                | Quebec.....   | 70               | 23        |         | 14        | 1 in 3                                | 1 in 5                                |
|                         | Totals.....   | 3,455            | 198       | 68      | 29        | 1 in 13                               | 1 in 119                              |
| Grand Totals.....       |               | 104,408          | 1,962     | 947     | 333       | 1 in 56                               | 1 in 314                              |

It has always been a matter of much interest and importance to compare the ratio of detentions and deportations by different steamship lines since it has been to some extent a measure of the care exercised by the agents in booking desirable immigrants.

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It will be noted that the number of detentions at Quebec of the Allan Line passengers was 1 in 57 in 1908-9 as compared with 1 in 202 in 1907-8, while the rejections were 1 in 270 as compared with 1 in 530 in 1907-8. There were of total passengers via Canadian Pacific Railway to Quebec 1 in 24 in 1908-9 detained as compared with 1 in 151 in 1907-8, while the debarred were 1 in 384 in 1908-9 as compared with 1 in 513 in 1907-8.

The Dominion line had 1 in 33 in 1908-9 detained at Quebec as compared with 1 in 141 in 1907-8, and 1 in 183 in 1908-9 debarred as compared with 1 in 590. The Donaldson line had 1 in 70 in 1908-9 detained at Quebec as compared with 1 in 100 in 1907-8, and 1 in 148 debarred as compared with 1 in 253. As regards the totals as compared with 1907-8, while the grand total of detentions is 1 in 36, the total debarred was 1 in 314, as compared with 1 in 327 for last year.

TABLE IV.—STATEMENT showing Number of Immigrants Detained and Debarred at Montreal, New York, North Sydney, Vancouver and Victoria, for Fiscal Year 1908-9.

| Port of Entry.   | Port of Arrival.  | Total Arriving. | Total Detained. | Total Debarred. | Total Released. | Still in Hospital. |
|------------------|-------------------|-----------------|-----------------|-----------------|-----------------|--------------------|
| Montreal.....    | Philadelphia..... | 43              |                 |                 |                 |                    |
|                  | Baltimore.....    | 29              |                 |                 |                 |                    |
|                  | Portland.....     | 1,806           | 165             | 10              | 155             |                    |
|                  | Boston.....       | 759             |                 |                 |                 |                    |
|                  | New York.....     | 8,463           |                 |                 |                 |                    |
| North Sydney.... | New York.....     | As above...     | 131             | 131             |                 |                    |
|                  | North Sydney..... | 4,572           | 4               | 4               |                 |                    |
| Vancouver.....   | Vancouver.....    | 6,896           | 64              | 14              | 50              |                    |
| Victoria.....    | Victoria.....     | 3,865           | 271             | 17              | 254             |                    |
|                  |                   | 26,433          | 635             | 176             | 459             |                    |

The most notable feature in the table is the increased care exercised by the medical officer of the department stationed in New York. Although the total number of immigrants for Canada arriving via New York decreased from 22,381 in 1907-8 to 8,463 in 1908-9, yet the number of rejections has increased from 106 to 131, or relatively from 1 in 211 to 1 in 65. In New York it is evident as at Canadian ports, that relatively the larger the number of immigrants the less is the relative number rejected, probably in part because the larger number up to even 9,000 in a single day, taxes at times the physical capacity of the inspectors beyond the limit of highest efficiency. At Vancouver the ratio of detentions to the total is much lower than at Victoria, as are also those refused admission, viz., of those detained 1 in 107 compared with 1 in 14 and of those debarred 1 in 492 as compared with 1 in 228. It will be remembered that a very notable number of immigrants landed at Victoria are booked to the United States, and that the detention is often made upon reasons given by the United States inspector. Further, as there are many vessels touching at Victoria which afterwards make for American ports, there would seem to be a less select lot of passengers than on vessels of the regular transpacific Canadian lines.

As in other years, the fact that almost all passengers coming from Newfoundland directly to Canada are on business or going to employment either in Canada or the United States adequately explains why only 4 in 4,572 passengers were detained and refused admission. The fact of the inspection has been sufficient to completely prevent the moving by the roundabout route of undesirables, sailing from Havre, debarking at St. John's from ships and then coming overland by rail and entering Canada by the regular mail steamers from the island.

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TABLE V.—STATEMENT by Nationalities of Number of Immigrants Debarred at Ocean Ports, showing Total Arrivals of the same Nationalities for the Fiscal Year 1908-9.

| Nationality.           | Total Arrivals for Canada and United States. | Atlantic Ports. |                    | Pacific Ports. |                    | Via United States Ports. | Totals.     |                    | Totals. |
|------------------------|--|-----------------|--------------------|----------------|--------------------|--------------------------|-------------|--------------------|---------|
|                        |  | For Canada.     | For United States. | For Canada.    | For United States. | For Canada.              | For Canada. | For United States. |         |
| Australian.....        | 362  |                 |                    | 2              | 1                  |                          | 2           | 1                  | 3       |
| Austrian, N.E.S.....   | 2,131  | 1               |                    |                |                    | 5                        | 6           |                    | 6       |
| Bohemian.....          | 37   |                 | 1                  |                |                    |                          |             | 1                  | 1       |
| Bukowinian.....        | 1,550  | 8               |                    |                |                    |                          | 8           |                    | 8       |
| Croatian.....          | 6  | 1               | 3                  |                |                    |                          |             | 3                  | 4       |
| Galician.....          | 6,710  | 16              |                    |                |                    |                          | 16          |                    | 16      |
| Hungarian, N.E.S.....  | 715  | 3               |                    |                |                    | 3                        | 6           |                    | 6       |
| Ruthenian.....         | 149  |                 |                    |                |                    | 29                       | 29          |                    | 29      |
| Belgian.....           | 913  |                 |                    |                |                    | 2                        | 2           |                    | 2       |
| Chinese.....           | 2,023  |                 |                    | 1              |                    |                          | 1           |                    | 1       |
| Dutch.....             | 568  | 2               |                    |                |                    |                          | 2           |                    | 2       |
| French.....            | 1,929  | 15              | 1                  |                |                    | 2                        | 17          | 1                  | 18      |
| German, N.E.S.....     | 1,682  | 11              | 6                  |                |                    | 2                        | 13          | 6                  | 19      |
| English.....           | 39,008                                       | 84              | 5                  |                | 1                  | 3                        | 87          | 6                  | 93      |
| Scotch.....            | 12,440                                       | 29              | 1                  |                |                    |                          | 29          | 1                  | 30      |
| Irish.....             | 3,900  | 15              |                    | 1              |                    | 6                        | 22          |                    | 22      |
| Greek.....             | 276  |                 | 3                  |                |                    |                          |             | 3                  | 3       |
| Hebrew, N.E.S.....     | 211  |                 |                    |                |                    | 3                        | 3           |                    | 3       |
| Hebrew, Russian.....   | 1,542  | 16              | 14                 |                |                    | 2                        | 18          | 14                 | 32      |
| Hebrew, Austrian.....  | 24   |                 |                    |                |                    | 1                        | 1           |                    | 1       |
| Hebrew, German.....    | 15   |                 | 1                  |                |                    |                          |             | 1                  | 1       |
| Italian.....           | 4,272  | 4               |                    |                |                    | 29                       | 33          |                    | 33      |
| Japanese.....          | 546  |                 | 5                  | 15             | 3                  | 3                        | 18          | 8                  | 26      |
| Newfoundland.....      | 3,050  | 3               |                    |                |                    |                          | 3           |                    | 3       |
| Poles, N.E.S.....      | 120  | 1               |                    |                |                    |                          | 1           |                    | 1       |
| " Austrian.....        | 44   |                 |                    |                |                    | 9                        | 9           |                    | 9       |
| " Russian.....         | 278  | 6               |                    |                |                    |                          | 6           |                    | 6       |
| Persian.....           | 1  |                 | 1                  |                |                    |                          |             | 1                  | 1       |
| Roumanian.....         | 313  |                 |                    | 1              |                    | 2                        | 3           |                    | 3       |
| Russian, N.E.S.....    | 5,091  | 36              | 21                 |                |                    | 30                       | 66          | 21                 | 87      |
| Finns.....             | 2,892  | 1               | 6                  |                |                    | 1                        | 2           | 6                  | 8       |
| Spanish.....           | 37   | 3               |                    |                |                    |                          | 3           |                    | 3       |
| Servian.....           | 50   |                 |                    |                |                    | 1                        | 1           |                    | 1       |
| Danish.....            | 444  |                 | 1                  |                |                    |                          |             | 1                  | 1       |
| Swedish.....           | 2,127  | 1               | 4                  |                |                    |                          | 1           | 4                  | 5       |
| Norwegian.....         | 2,542  |                 |                    |                |                    | 5                        | 5           |                    | 5       |
| Turks.....             | 279  | 2               | 1                  |                |                    |                          | 2           | 1                  | 3       |
| Armenians.....         | 211  | 1               | 1                  |                |                    |                          | 1           | 1                  | 2       |
| Syrian.....            | 227  | 2               |                    |                |                    | 2                        | 4           |                    | 4       |
| Arabian.....           | 4  |                 |                    |                |                    | 1                        | 1           |                    | 1       |
| United States citizens | 2,728  |                 | 1                  | 1              |                    |                          | 1           | 1                  | 2       |
| Hindoo.....            | 8  |                 |                    | 5              |                    |                          | 5           |                    | 5       |
| Totals.....            | 101,455                                      | 261             | 76                 | 26             | 5                  | 141                      | 428         | 81                 | 509     |

As remarked in regard to other tables, the smaller the number of any nationality, the less reliable are any statistics dealing with them. Thus, in the preceding table the Ruthenians are rejected to the number of 29 in a total of 149, the abnormal number debarred being really due to Ruthenian being an ethnic term applicable to Galicians, Bukowinians or Slovaks, referring rather to language and country, and not generally used, the nationality being given. It appears, however, that more than twice as many proportionately of Bukowinians were debarred as compared with Galicians. Both French and German show an abnormally high number debarred, over 9 per 1,000 as compared with English and Scotch between 2 and 3 per 1,000. Russians appear high, being 17 per 1,000, while the Italians are 8 per 1,000 or half as numerous. There were 48 Japanese per 1,000, but only 0.5 of Chinese. Both Swedes and Norwegians are low, being 2 per 1,000, but the Finns are 3 per 1,000.



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Taken together, however, the total 509 debarred was rather less per 1,000 than in 1907-8, compared with the total immigration, the ratio being 1 in 171 as compared with 1 in 174 in 1907-8. It will not be forgotten that the great precautions taken, especially in England and at Hong Kong in 1908-9, prevented, doubtless, numbers sailing of the less desirable class.

TABLE VI.—STATEMENT showing the Total Number of Chinese, Japanese and Hindoos detained, released and debarred at the Ports of Vancouver and Victoria, during the Fiscal Year 1908-9.

| Nationality.      | Total Number Arriving. | Detained. | Released. | Debarred. | Number still in Hospital. |
|-------------------|------------------------|-----------|-----------|-----------|---------------------------|
| <b>Vancouver—</b> |                        |           |           |           |                           |
| Chinese.....      | 1,209                  | 36        | 35        | 1         |                           |
| Japanese.....     | 81                     | 22        | 15        | 7         |                           |
| Hindoos.....      |                        |           |           |           |                           |
| Totals.....       | 1,290                  | 58        | 50        | 8         |                           |
| <b>Victoria—</b>  |                        |           |           |           |                           |
| Chinese.....      | 778                    | 247       | 247       |           |                           |
| Japanese.....     | 453                    | 18        | 7         | 11        |                           |
| Hindoos.....      | 5                      |           |           | 5         |                           |
| Totals.....       | 1,236                  | 270       | 254       | 16        |                           |

For 1908-9 the total number of Orientals arriving at Vancouver and Victoria was 2,526, as compared with 12,920 in 1907-8, the Chinese immigration maintaining a very even ratio from year to year, but the Japanese to Vancouver having practically ceased arriving. The number arriving by the various transpacific lines touching at Victoria is greater, it being not unusual for Japanese, going to the United States ultimately, to book to Victoria on the steamers which make it their first port of call. The total debarred of the whole immigration was 24 in 2,526 or 10 per 1,000.

TABLE VII.—STATEMENT showing the Disease and other causes for which Immigrants were detained at the Ports of Quebec, Halifax, St. John, Montreal, North Sydney, Vancouver, Victoria and New York, during the Fiscal Year 1908-9.

| Class of Disease.           | Cause of Detention. | Number Detained. | Number Released. | Number Rejected. | Number still in Hospital. |
|-----------------------------|---------------------|------------------|------------------|------------------|---------------------------|
| I. Contagious diseases..... | Scarlet fever.....  | 1                | (died 1)         |                  |                           |
|                             | Measles.....        | 10               | (died 1) 9       |                  |                           |
|                             | Erysipelas.....     | 3                | 3                |                  |                           |
|                             | Typhoid fever.....  | 1                | 1                |                  |                           |
|                             | Totals.....         | 15               | 15               |                  |                           |
| II. General diseases.....   | Tuberculosis.....   | 18               | (died 1) 5       | 12               |                           |
|                             | Lupus.....          | 1                |                  | 1                |                           |
|                             | Alcoholism.....     | 8                | 3                | 5                |                           |
|                             | Furuncle.....       | 1                | 1                |                  |                           |
|                             | Rheumatism.....     | 3                | 3                |                  |                           |
| Totals.....                 | 31                  | 13               | 18               |                  |                           |

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TABLE VII.—STATEMENT showing the Disease and other causes for which Immigrants were detained at the Ports of Quebec, Halifax, St. John, Montreal, North Sydney, Vancouver, Victoria and New York during the Fiscal Year 1908-9—Continued.

| Class of Disease.           | Cause of Detention.                  | Number Detained. | Number Released. | Number Rejected. | Number still in Hospital. |
|-----------------------------|--------------------------------------|------------------|------------------|------------------|---------------------------|
| III. Eye diseases.          | Trachoma                             | 456              | 340              | 94               | 22                        |
|                             | Conjunctivitis                       | 339              | 329              | 1                |                           |
|                             | Corneal ulcer                        | 4                | 4                |                  |                           |
|                             | Choroiditis                          | 1                |                  | 1                |                           |
|                             | Trachomatous cicatrization           | 19               | 19               |                  |                           |
|                             | Cataract                             | 1                |                  | 1                |                           |
|                             | Defective sight                      | 18               | 10               | 7                | 1                         |
|                             | Blindness                            | 1                |                  | 1                |                           |
|                             | Loss of an eye                       | 9                |                  | 9                |                           |
|                             | Pterygium                            | 2                | 2                |                  |                           |
|                             | Corneal opacity                      | 1                |                  | 1                |                           |
|                             | Observation of the eyes              | 66               | 65               |                  | 1                         |
|                             | Totals                               |                  | 908              | 769              | 115                       |
| IV. Nervous system          | Insanity                             | 15               | 1                | 13               | 1                         |
|                             | Hysteria                             | 1                |                  | 1                |                           |
|                             | Epilepsy                             | 2                | 1                |                  | 1                         |
|                             | Paralysis                            | 4                | 2                | 1                | 1                         |
|                             | Feeble-minded                        | 37               | 14               | 23               |                           |
|                             | Locomotor ataxia                     | 1                |                  | 1                |                           |
|                             | Muscular atrophy                     | 2                |                  | 2                |                           |
|                             | Nervousness                          | 1                | 1                |                  |                           |
|                             | Homicidal delusions                  | 1                |                  |                  | 1                         |
|                             | Observation of mind                  | 4                | 4                |                  |                           |
| " nervous system            | 2                                    | 2                |                  |                  |                           |
| Totals                      |                                      | 70               | 25               | 41               | 4                         |
| V. Circulatory system       | Heart disease                        | 9                | 4                | 5                |                           |
|                             | Varicose veins                       | 1                |                  | 1                |                           |
|                             | Totals                               |                  | 10               | 6                |                           |
| VI. Respiratory system      | Bronchitis                           | 1                | 1                |                  |                           |
|                             | Tonsilitis                           | 2                | 2                |                  |                           |
|                             | Pneumonia                            | 10               | (died 1)8        |                  | 1                         |
|                             | Inflammation of lungs                | 1                | 1                |                  |                           |
|                             | Emphysema                            | 1                |                  | 1                |                           |
|                             | Hemorrhage                           | 1                | (died 1)         |                  |                           |
|                             | Observation of lungs                 | 1                | 1                |                  |                           |
|                             | Non-malignant growth on vocal chords | 1                | 1                |                  |                           |
|                             | Totals                               |                  | 18               | 16               | 1                         |
| VII. Digestive system       | Hernia                               | 5                | 1                | 3                | 1                         |
|                             | Appendicitis                         | 4                | (died 1)3        |                  |                           |
|                             | Enteritis                            | 1                | 1                |                  |                           |
|                             | Cirrhosis liver                      | 1                |                  | 1                |                           |
|                             | Dysentery                            | 3                | 3                |                  |                           |
|                             | Intestinal hemorrhage                | 1                | 1                |                  |                           |
| Totals                      |                                      | 15               | 10               | 4                | 1                         |
| VIII. Genito-urinary system | Syphilis                             | 2                |                  | 2                |                           |
|                             | Gonorrhœa                            | 1                |                  | 1                |                           |
|                             | Conjestion of kidneys                | 1                | 1                |                  |                           |
|                             | Totals                               |                  | 4                | 1                | 3                         |

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TABLE VII.—STATEMENT showing the Disease and other causes for which Immigrants were detained at the Ports of Quebec, Halifax, St. John, Montreal, North Sydney, Vancouver, Victoria and New York during the Fiscal Year 1908-9—*Concluded.*

| Class of Disease.  | Cause of Detention.                             | Number Detained.   | Number Released. | Number Rejected. | Number still in Hospital. |
|--|---|--------------------|------------------|------------------|---------------------------|
| IX. The skin.....  | Favus.....                                      | 9                  | 6                | 2                | 1                         |
|  | Scabies.....                                    | 2                  | 1                | 1                |                           |
|  | Eczema.....                                     | 1                  | 1                |                  |                           |
|  | Trinea (ringworm).....                          | 19                 | 14               | 5                |                           |
|  | Impetigo.....                                   | 1                  | 1                |                  |                           |
|  | Acne.....                                       | 1                  | 1                |                  |                           |
|  | Leprosy.....                                    | 1                  |                  | 1                |                           |
|  | Psoriasis.....                                  | 1                  |                  | 1                |                           |
|  | Pediculosis.....                                | 1                  | 1                |                  |                           |
|  | Totals.....                                     | 36                 | 25               | 10               | 1                         |
| X. Malformations and diseases<br>of old age and infancy..... | Cripple.....                                    | 1                  |                  | 1                |                           |
|  | Deafness.....                                   | 4                  | 3                | 1                |                           |
|  | Old age.....                                    | 2                  |                  | 2                |                           |
|  | Hare lip.....                                   | 1                  |                  | 1                |                           |
|  | Cholera infantum.....                           | 1                  | (died 1)         |                  |                           |
|  | Tumor.....                                      | 1                  | 1                |                  |                           |
|  | Abscess.....                                    | 2                  | 2                |                  |                           |
| Totals.....  | 12  | 7                  | 5                |                  |                           |
| XI. Accidents.....   | Bruise.....                                     | 1                  | 1                |                  |                           |
|  | Scald.....                                      | 2                  | (died 1) 1       |                  |                           |
|  | Frostbite.....                                  | 1                  | 1                |                  |                           |
|  | Amputated fingers.....                          | 1                  | 1                |                  |                           |
|  | Hip operation.....                              | 1                  | 1                |                  |                           |
|  | Sprained ankle.....                             | 1                  | 1                |                  |                           |
|  | Concussion.....                                 | 1                  | (died 1)         |                  |                           |
| Totals.....  | 8   | 8                  |                  |                  |                           |
| XII. Ill-defined causes.....                                 | Poor physique.....                              | 20                 | 11               | 8                | 1                         |
|  | Physical debility.....                          | 8                  | (died 1) 3       | 4                |                           |
|  | Lack of nutrition.....                          | 1                  | (died 1)         |                  |                           |
|  | High temperature.....                           | 6                  | 6                |                  |                           |
|  | Totals.....                                     | 35                 | 22               | 12               | 1                         |
| XIII. Other causes.....                                      | Accompanying patients.....                      | 255                | 194              | 61               |                           |
|  | Likely to become a public charge ..             | 1,976              | 1,837            | 130              | 9                         |
|  | Stowaways.....                                  | 78                 | 8                | 70               |                           |
|  | Contract labour for United States.....          | 7                  | 7                |                  |                           |
|  | Held for inquiry.....                           | 14                 | 14               |                  |                           |
|  | Contravention of Order in Council.....          | 6                  |                  | 6                |                           |
|  | Fraudulent pass.....                            | 1                  |                  | 1                |                           |
|  | Criminal.....                                   | 11                 | 5                | 6                |                           |
|  | Prostitute.....                                 | 1                  |                  | 1                |                           |
|  | Illegal co-habitation.....                      | 4                  |                  | 4                |                           |
|  | With illegitimate child.....                    | 3                  | 2                | 1                |                           |
|  | Confinement.....                                | 2                  | 2                |                  |                           |
|  | Pregnancy.....                                  | 1                  |                  | 1                |                           |
|  | Moral turpitude.....                            | 7                  |                  | 7                |                           |
|  | Held for observation.....                       | 10                 | 10               |                  |                           |
|  | Not continuous journey from native<br>land..... | 6                  |                  | 6                |                           |
| Totals.....  | 2,382   | 2,079              | 294              | 9                |                           |
| Grand totals.....  | 3,544   | 2,994<br>(died 11) | 509              | 41               |                           |

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The preceding table gives the list of persons detained and placed in the detention hospitals at the several seaports for all causes in 1908-9 as 3,544, as compared with 4,638 in 1907-8. The marked falling off in the total immigration this year has been already noted and it will be seen that in 1908-9 more proportionately have been under the heading of 'Likely to become a public charge,' there having been 1,976 detained as compared with 178 in the previous year. The financial requirements were met especially by friends in Canada as seen in the fact that 1,837 were subsequently released and sent forward. The criminals were 11 as compared with 21 in the previous year. Under the classes of disease there were a few cases of acute contagion, especially 'measles,' developed, as in former years. Their paucity during the past five years has been very remarkable, there having been only the following:—

| Disease.           | 1904-5. | 1905-6. | 1906-7. | 1907-8. | 1908-9. |
|--------------------|---------|---------|---------|---------|---------|
| Scarlet fever..... |         |         |         |         | 1       |
| Diphtheria.....    |         | 2       |         |         |         |
| Quinsy.....        |         | 1       |         |         |         |
| Chickenpox.....    |         |         | 1       |         |         |
| Measles.....       | 1       | 19      | 4       | 18      | 10      |
| Erysipelas.....    |         |         |         | 1       | 3       |
| Typhoid.....       |         |         | 1       | 2       | 1       |
| Mumps.....         |         |         | 1       | 1       |         |

Of the constitutional diseases in Class II, as might be expected, 'tuberculosis' shows the most cases, 18 in all, of whom 1 died in hospital and 10 were deported. Last year 27 were detained and 11 deported. Cases of chronic drunkenness have been dealt with promptly, 8 having been detained and 5 deported as 'alcoholics' as compared with one last year. Such are clearly a class for which Canada has no need or any room. Probably the most notable decrease in disease is in Class III., including eye diseases. Last year 2,856 were detained and 385 deported, whereas in 1908-9 there were 908 only detained and but 115 deported. The notable decrease is in consequence of the less detentions on account of ophthalmia in Orientals. Class IV. includes diseases of the nervous system under which are the detentions for insanity, these being 15 as compared with 20 in the previous year, of whom 13 were debarred.

There were fewer epileptics, 2 as compared with 8 in the previous year, but 37 were detained as 'feeble-minded' as compared with 18, of whom 23 were rejected as compared with 13 last year.

Class V., 'Diseases of Circulation,' has but 10 cases, of which 5 cases of heart disease were deported. Similarly Class VI. has but 18 cases, including bronchitis and pneumonia, this being good proof that there was not overcrowding on shipboard.

Class VII., 'Diseases of the Digestive system,' naturally has few, most of them being chronic 'hernia.'

Similarly, Class VIII. has, as could be expected, but few cases.

Class IX. has the usual number of 'Diseases of the Skin,' especially of the two chronic contagious ones, 'favus' and 'ringworm,' there being 9 of the former and 19 of the latter as compared with 10 and 64 last year. They were either deported or kept in hospital and treated at the expense of the steamship companies, being otherwise desirable.

Under Classes X., XI. and XII. were included 55 cases of malformations, injuries and other ill-defined causes.

Taken all together the competent observer will agree that in the total inspected at the seaports, the list illustrates a remarkable freedom from disease in the immigrants arriving in Canada, and that the sitting has been thorough will be drawn from a later table showing the small number of cases deported on account of disease.

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TABLE VIII.—STATEMENT of Deportations from Canada during the Fiscal Year 1908-9,  
by Nationalities.

|                            |       |                            |       |
|----------------------------|-------|----------------------------|-------|
| African, South.. . . . .   | 1     | Hebrew, N.E.S.. . . . .    | 32    |
| Australian.. . . . .       | 1     | Hebrew, Russian.. . . . .  | 11    |
| Austrian, N.E.S.. . . . .  | 17    | Hebrew, Austrian.. . . . . | 2     |
| Bohemian.. . . . .         | 3     | Italian.. . . . .          | 13    |
| Buckowinian.. . . . .      | 4     | Japanese.. . . . .         | 4     |
| Galician.. . . . .         | 16    | Polish, Russian.. . . . .  | 3     |
| Hungarian, N.E.S.. . . . . | 1     | Roumanian.. . . . .        | 42    |
| Ruthenian.. . . . .        | 1     | Russian, N.E.S.. . . . .   | 49    |
| Belgian.. . . . .          | 2     | Finnish.. . . . .          | 3     |
| Bulgarian.. . . . .        | 74    | Spanish.. . . . .          | 1     |
| Chinese.. . . . .          | 1     | Swiss.. . . . .            | 2     |
| Dutch.. . . . .            | 12    | Danish.. . . . .           | 4     |
| French.. . . . .           | 18    | Swedish.. . . . .          | 7     |
| German.. . . . .           | 7     | Norwegian.. . . . .        | 2     |
| English.. . . . .          | 1,081 | Turkish.. . . . .          | 20    |
| Welsh.. . . . .            | 1     | Syrian.. . . . .           | 1     |
| Scotch.. . . . .           | 119   | U. S. Citizens.. . . . .   | 98    |
| Irish.. . . . .            | 34    | Negro.. . . . .            | 1     |
| West Indian.. . . . .      | 3     | Hindoo.. . . . .           | 24    |
| Jamaican.. . . . .         | 1     |                            |       |
| Greek.. . . . .            | 32    | Grand total.. . . . .      | 1,748 |

TABLE IX.—STATEMENT of Deportations from Canada during Fiscal Year 1908-9,  
by Causes.

|                                    |     |  |       |
|------------------------------------|-----|--|-------|
| I. General—                        |     | VI. Digestion—                         |       |
| Tuberculosis.. . . . .             | 54  | Hernia.. . . . .                       | 2     |
| Alcoholism.. . . . .               | 27  | Fistula.. . . . .                      | 1     |
| Rheumatism.. . . . .               | 15  | VII. Genito-urinary—                   |       |
| Syphilis.. . . . .                 | 4   | Chronic cystitis (bladder).. . . . .   | 1     |
| Diabetes.. . . . .                 | 2   | Kidneys (Bright's).. . . . .           | 2     |
| Cancer.. . . . .                   | 2   | VIII. The skin—                        |       |
| Abscess.. . . . .                  | 1   | Eczema.. . . . .                       | 1     |
| Anaemia.. . . . .                  | 1   | IX. Malformation—                      |       |
| Exophthalmia.. . . . .             | 1   | Senility.. . . . .                     | 10    |
| Hip disease.. . . . .              | 1   | Deafness.. . . . .                     | 4     |
| II. Eyes—                          |     | Blindness.. . . . .                    | 3     |
| Defective sight.. . . . .          | 11  | Spinal curvature.. . . . .             | 1     |
| Cataract.. . . . .                 | 1   | Crippled.. . . . .                     | 11    |
| Trachoma.. . . . .                 | 1   | Potts disease.. . . . .                | 2     |
| III. Nerves—                       |     | X. Accident—                           |       |
| Insane.. . . . .                   | 113 | Frostbite.. . . . .                    | 3     |
| Feeble-minded.. . . . .            | 35  | Injured.. . . . .                      | 3     |
| Epilepsy.. . . . .                 | 22  | Rupture.. . . . .                      | 6     |
| Paralysis.. . . . .                | 4   | XI. Ill-defined—                       |       |
| Nervous debility.. . . . .         | 1   | Physical debility.. . . . .            | 82    |
| Loss of memory.. . . . .           | 1   | Physical and mental debility.. . . . . | 14    |
| Paresis.. . . . .                  | 1   | XII. Other—                            |       |
| Acute nostalgia.. . . . .          | 1   | Public charge.. . . . .                | 1,074 |
| IV. Circulatory—                   |     | Criminal.. . . . .                     | 115   |
| Heart disease.. . . . .            | 13  | Vagrancy.. . . . .                     | 56    |
| Varicose veins and ulcer.. . . . . | 7   | Accompanying.. . . . .                 | 21    |
| V. Respiratory—                    |     | Prostitution.. . . . .                 | 8     |
| Bronchitis.. . . . .               | 1   | Bad character.. . . . .                | 7     |
| Emphysema.. . . . .                | 1   |  |       |

The causes for deportation are seen to have been chiefly civil rather than medical, there having been 1,074 public charges. Those deported for criminal causes show a remarkable increase over the previous year, there being 115 as compared with 49. It illustrates the truth contained in immigration returns of different past periods that whenever there has been a depression in business and a lack of employment, there is an increase in criminal returns, part of it being due to the fact that many vagrants and others have charges preferred against them in order that they may be taken charge of.

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As usual the larger number of deports are included in two classes of general constitutional diseases and nervous diseases. Of the first there were 108, including 54 cases of tuberculosis and 27 of alcoholism. Of nervous diseases there were in all 178, including 113 cases of insanity, 35 feeble-minded and 22 cases of epilepsy.

The cases both of tuberculosis and insanity approximate the total of 1907-8, being 54 as compared with 70 and 113 as compared with 122. That the deportation of 'chronic' undesirables is being steadily carried out is best illustrated by the fact that 27 were deported on account of alcoholism as compared with 1 in 1907-8, as well as by the fact that 35 feeble-minded were deported as compared with 13 last year and 22 epileptics as compared with 10 the previous year.

The remarkable results of constant inspection of immigrants for eye trouble are seen in the fact that only 1 person was deported on account of trachoma and 12 for defective sight from all causes.

Various other diseases were causes of deportation, but no one of them assumed any degree of importance.

The foregoing tables have illustrated the various features of medical interest in the immigration of 1908-9, so far as the work in Canada is concerned. What was done in foreign countries, as England, to prevent the unfit from taking passage, will appear elsewhere; but that many were so prevented through an examination and certificate being required in many cases may fairly be inferred. Comparison of those rejected with those of previous years shows that the number finally rejected at the seaports has not notably differed in ratio from those in 1907-8 and seems to indicate that the approximate maximum of efficient work at the seaports under existing methods of inspection and requirements of the Act has been reached. The deportations as illustrated in the preceding table for the most part of persons from Great Britain and Europe, have removed from amongst the newcomers the dregs, until it is probable that fewer defectives per 1,000 actually exist in the immigrants than in an equal number of the same class amongst the native born. The notable absence of mental defectives amongst the peoples from southern countries is a matter of much interest and, contrary to a too popular opinion, it appears that if compulsory education can be generally enforced we have in such races not only an industrial asset of great value but also the assurance of a population remarkably free from the degenerative effects seen in those classes which have been for several generations factory operatives and dwellers in the congested centres of large industrial populations. Recognizing the constant and increasing need of a population, not only capable of but willing to do the rougher work of opening up new areas by building railways and canals, we may consider it a fortunate matter if such can be obtained of clean blood and much native energy, only requiring the influence of social and educational environments to transform them into good citizens and absorb them into the masses of our law-abiding and progressive communities.

Respectfully submitted,

P. H. BRYCE,

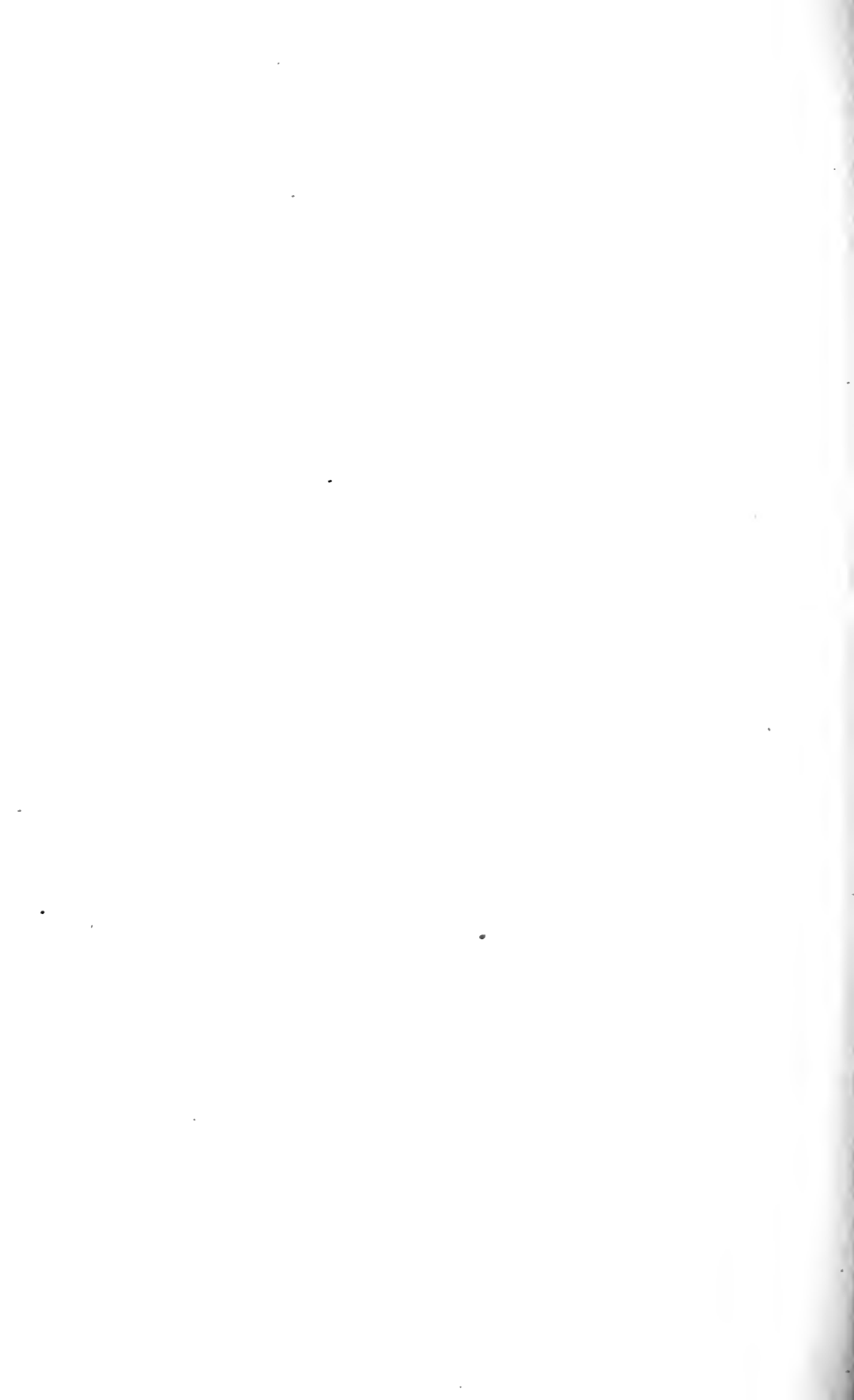
*Chief Medical Officer.*







PART III  
SURVEYS



# SURVEYS

## REPORT OF THE SURVEYOR GENERAL.

DEPARTMENT OF THE INTERIOR,

TOPOGRAPHICAL SURVEYS BRANCH,

OTTAWA, May 27, 1909.

The Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit the following report of the Topographical Surveys Branch for the fiscal year ended March 31, 1909.

During 1908 there was a demand for extensive surveys in what was formerly called the 'semi-arid' district, those portions of the northwest provinces lying between the Canadian Pacific railway and the international boundary and between Moosejaw and Lethbridge. About one hundred and forty-five townships in this district were subdivided during the year. It is expected that the surveys in this tract will be completed during 1909. Surveys were also extended in the country north and west of Edmonton, north and east of Prince Albert and in the northern part of Manitoba.

To secure more permanent monuments for quarter section corners it was decided to use iron posts instead of wooden ones. Formerly iron posts were used only at section corners. Many surveys in wooded country are performed during the winter. Iron posts as well as being more permanent, are much more easily driven into the frozen ground.

Formerly the laws governing the survey of Dominion lands were comprised within the Dominion Lands Act, but in 1908 they were embodied in a separate Act called the Dominion Lands Surveys Act which was assented to March 17, 1908. The chief changes by the new Act are in relation to the resurveys of lands and the correction of errors; the Minister is given power to order a resurvey upon receipt of a petition from the owners of the lands or from parties interested as homesteaders, licensees, &c., and after public notice has been given in the *Canada Gazette* and a local newspaper for a period of four weeks. In the case of the correction of errors provision is made for compensation on account of the loss of improvements by the correction. This compensation is payable by the party acquiring the improvements, and the amount is fixed by the Minister or by an award of three arbitrators. Several resurveys and a few correction surveys have been already made under the provisions of the new Act.

### SURVEYS FOR THE YEAR ENDED MARCH 31, 1909.

Like the spring of 1907, the spring of 1908 was unusually wet and surveyors had great difficulties in taking their outfits and supplies to the different localities where they were to work. Progress in the early part of the season was slow but after the wet period was over, the weather generally was very favourable for survey operations. Complete subdivision was made of three hundred and twelve whole and of twenty-three fractional townships, while a partial subdivision was made of one hundred and sixty-one other townships. In addition a complete resurvey was made of fifteen whole townships and of five fractional ones as well as a partial resurvey of one hundred and fifty-one others.

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Seventy survey parties were in the field, sixty of which were engaged on township work and ten on miscellaneous surveys. Thirty-nine of these parties were paid by the day and thirty-one worked under contract. Of the parties under daily pay, four were employed in Manitoba, six in Saskatchewan, fifteen in Alberta, eight in British Columbia, one on the boundary between British Columbia and Yukon Territory and two in the Northwest Territories, while three others were part of the time in one province and part of the time in another. Of the parties under contract seven were located in Manitoba, eight in Saskatchewan and fifteen in Alberta, while one contract was partly in one province and partly in another.

Five parties under daily pay in charge of Messrs. P. R. A. Belanger, E. W. Hubbell, G. J. Lonergan, C. F. Miles and L. E. Fontaine were engaged for the greater part of the time on the inspection of surveys performed under contract. Forty contracts were examined during the year. The balance of the time of the inspectors was given to the investigation of reported errors, the correction of errors and the performance of other miscellaneous surveys.

The reports of the surveyors who were working under daily pay are given as appendices No. 13 to No. 50 of this report. The field of operations embraced the country extending from the eastern boundary of Manitoba to the western boundary of Alberta and from the international boundary as far north as township 107, a distance of about 650 miles. It embraced, also, almost the entire railway belt in British Columbia.

#### MISCELLANEOUS CORRECTION, RESTORATION AND TOWNSHIP SUBDIVISION SURVEYS.

Mr. C. F. Aylsworth, D.L.S., continued resurvey work in the vicinity of Beausejour, in eastern Manitoba.

Messrs. C. E. Bourgault, D.L.S., and W. J. Deans, D.L.S., made several correction surveys and some resurveys in eastern Saskatchewan. Mr. Deans travelled more than 500 miles during the performance of his surveys. He found the great need in that country to be an adequate system of drainage.

Messrs. T. A. Davies, D.L.S., Jas. Warren, D.L.S., and W. H. Young, D.L.S., were engaged in extending subdivision surveys in southwestern Alberta, in the foothills of the Rocky mountains. Owing to the nature of the country survey operations in this vicinity are very tedious and difficult.

Mr. Thos. Fawcett, D.T.S., retraced a portion of the fourth meridian in southern Alberta and made several correction surveys in Saskatchewan. His report contains an interesting description of the country he passed over.

Messrs. Geo. McMillan, D.L.S., W. R. Reilly, D.L.S., and R. H. Montgomery, D.L.S., were engaged in miscellaneous resurveys and correction surveys in the vicinity of Prince Albert, Saskatchewan. Mr. Reilly expresses the opinion that the north country offers special inducements to the settler of small means, as the wooded homestead furnishes timber for building and wood for fuel, while winter employment may always be had with the lumbering companies.

Mr. T. H. Wiggins, D.L.S., was engaged for only a short period on a correction survey near Saskatoon, Saskatchewan.

#### SUBDIVISION SURVEYS IN THE PEACE RIVER DISTRICT.

Messrs. H. S. Holcroft, D.L.S., J. B. Saint Cyr, D.L.S., and H. W. Selby, D.L.S., were employed on necessary township subdivision and settlement surveys in the Peace River district. They all speak well of the success which settlers are meeting with in that country and foretell a prosperous future, when satisfactory means of transportation will be available.

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## SURVEYS OF BLOCK OUTLINES.

Portions of the eighth and ninth base lines west of the principal meridian were resurveyed by Wm. Christie, D.L.S., to locate an error which was indicated by the closings of these lines with other lines previously surveyed. The accuracy of subdivision surveys depends on the accuracy of the base lines; it was therefore necessary to locate and correct the error before the dependent subdivision surveys could be proceeded with.

Mr. A. H. Hawkins, D.L.S., surveyed a portion of the twelfth base and completed the survey of the thirteenth base west of the sixth meridian while Mr. A. Saint Cyr, D.L.S., surveyed a portion of the fifteenth base west of the fifth meridian and produced the sixth meridian from the fourteenth base south to the quarter section corner on the east boundary of section 25 in township 47. A perusal of the reports of Messrs. Hawkins and Saint Cyr will give a clear idea of the almost insurmountable difficulties encountered by surveyors who undertake the surveys of the governing lines in our system of survey.

Mr. A. W. Ponton, D.L.S., produced the fifth initial meridian through townships 55 to 107, inclusive. It was necessary to establish this meridian in order that base lines might be extended from it in any direction where subdivision may be required. Large settlements are already in existence on Peace river and there is some demand for subdivision surveys.

Mr. B. J. Saunders, D.L.S., produced the eleventh base line west of the fifth meridian from range 8 to range 19.

## MISCELLANEOUS SURVEYS.

Mr. David Beatty, D.L.S., made a compass survey of the limits of Porcupine forest reserve northwest of Swan River, Manitoba.

Mr. A. McFee, D.L.S., surveyed the boundaries of Buffalo Park reserve near Hardisty, Alberta.

Some necessary surveys at The Pas in the Northwest Territories were performed by Mr. E. R. Bingham, D.L.S. He foretells an important future for this settlement when the Canadian Northern railway is completed that far.

Mr. P. A. Carson, D.L.S., continued the triangulation in the railway belt, British Columbia, south and west of Golden.

A survey to locate some coal lands on the south branch of Brazeau river in Alberta was made by Mr. T. D. Green, D.L.S.

Mr. J. E. Morrier, D.L.S., surveyed a townsite at Fort Churchill. His report gives much valuable information as to the conditions of life there and the possibilities of the country.

Necessary surveys at lakes Louise and Minnewanka, in the Rocky Mountains park, were done by Mr. A. C. Talbot, D.L.S.

Mr. W. Thibaudau, C.E., made a preliminary investigation of the water-powers of several streams in southwestern Alberta. A mass of valuable information is furnished by his report and the maps to accompany it, which are published herewith.

Mr. J. N. Wallace, D.L.S., established the Yukon-British Columbia boundary between the Tatshenshini and Takhini rivers, a distance of about thirty-six miles.

An examination of the vacant lands in the valleys of the railway belt, British Columbia was undertaken by Mr. A. O. Wheeler, D.L.S., for the purpose of classifying them under five heads, viz., fruit land, farming land, grazing land, timber land and worthless land. Mr. Wheeler had under his direction two sub-parties in charge of Messrs. M. P. Bridgland, D.L.S., and H. G. Wheeler respectively. The valley lands above and below Revelstoke and above Golden were examined.

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## BRITISH COLUMBIA SURVEYS.

For some years past two surveyors, Messrs. J. E. Ross, D.L.S., and A. W. Johnson, D.L.S., have conducted practically all the Dominion land surveys in the railway belt. Owing to the great increase of work consequent upon the assumption by the Department of the control of timber berth surveys and upon the considerable increase in the applications for subdivision surveys it was found necessary last year to employ two more parties under Messrs. T. H. Plunkett, D.L.S., and E. W. Robinson, D.L.S., respectively. These two parties, as well as the party under Mr. A. W. Johnson, were engaged in the Kamloops district. Mr. J. E. Ross was employed in the western portion of the railway belt. Some small surveys were performed by Mr. J. A. Kirk, D.L.S.

## LATITUDE ON THE FIFTH MERIDIAN.

In the spring of 1908 Mr. G. Blanchard Dodge determined the latitude of the fifth meridian near the Athabaska river in order to ascertain the error in latitude of the corner monuments near that place. The fifth meridian was being extended northerly to the Peace river by Mr. A. W. Ponton and to guard against errors in chainage, he was instructed to observe for latitude from time to time, but this could not serve as a check unless he knew the error at his starting point near the Athabaska river. It was shown by Mr. Dodge's observation that the error was practically nothing.

The following is a comparison of the mileage surveyed every year since 1906:—

|                              | April 1, 1908,<br>to<br>March 31, 1909. | April 1, 1907,<br>to<br>March 31, 1908. | Jan. 1, 1906,<br>to<br>March 31, 1907. |
|------------------------------|---|---|--|
|                              | Miles.                                  | Miles.                                  | Miles.                                 |
| Township outlines.....       | 2,019                                   | 1,674                                   | 1,306                                  |
| Section lines.....           | 16,985                                  | 13,710                                  | 8,962                                  |
| Traverse.....                | 3,323                                   | 3,193                                   | 1,848                                  |
| Resurvey.....                | 2,175                                   | 2,917                                   | 4,948                                  |
| Total for season.....        | 24,502                                  | 21,494                                  | 17,064                                 |
| Number of parties.....       | 67                                      | 59                                      | 56                                     |
| Average miles per party..... | 366                                     | 364                                     | 305                                    |

The following table shows the mileage surveyed by the parties under daily pay, and by the parties under contract:—

## WORK OF PARTIES UNDER DAILY PAY.

|                              | April 1, 1908,<br>to<br>March 31, 1909. | April 1, 1907,<br>to<br>March 31, 1908. | Jan. 1, 1906,<br>to<br>March 31, 1907. |
|------------------------------|---|---|--|
|                              | Miles.                                  | Miles.                                  | Miles.                                 |
| Township outlines.....       | 512                                     | 542                                     | 756                                    |
| Section lines.....           | 1,004                                   | 975                                     | 1,035                                  |
| Traverse.....                | 1,158                                   | 1,313                                   | 643                                    |
| Resurvey.....                | 2,175                                   | 2,782                                   | 4,815                                  |
| Total for season.....        | 4,849                                   | 5,612                                   | 7,249                                  |
| Number of parties.....       | 36                                      | 29                                      | 29                                     |
| Average miles per party..... | 135                                     | 194                                     | 250                                    |

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## WORK OF PARTIES UNDER CONTRACT.

|                              | April 1, 1908,<br>to<br>March 31, 1909. | April 1, 1907,<br>to<br>March 31, 1908. | Jan. 1, 1906,<br>to<br>March 31, 1907. |
|------------------------------|---|---|--|
|                              | Miles.                                  | Miles.                                  | Miles.                                 |
| Township outlines.....       | 1,507                                   | 1,132                                   | 550                                    |
| Section lines.....           | 15,981                                  | 12,735                                  | 7,927                                  |
| Traverse.....                | 2,165                                   | 1,880                                   | 1,205                                  |
| Resurvey.....                |   | 135                                     | 133                                    |
| Total for season.....        | 19,653                                  | 15,882                                  | 9,815                                  |
| Number of parties.....       | 31                                      | 30                                      | 27                                     |
| Average miles per party..... | 634                                     | 529                                     | 364                                    |

NOTE.—Owing to the nature of their work the parties under Messrs. P. A. Carson, W. Thibaudeau and A. O. Wheeler are not included in the statement of mileage for the year ended March 31, 1909.

The following statement shows the average cost per mile of surveys done by contractors and by surveyors under daily pay for the year ended March 31, 1909 :—

|                             | Surveys made<br>under<br>daily pay. | Surveys made<br>under<br>contract. |
|-----------------------------|-------------------------------------|------------------------------------|
| Total mileage surveyed..... | 4,849                               | 19,653                             |
| Total cost.....             | \$ 323,054 13                       | \$ 358,364 61                      |
| Average cost per mile.....  | 66 62                               | 18 23                              |

## DESCRIPTIONS OF TOWNSHIPS.

Descriptions of the townships subdivided during the year have been compiled from the surveyors' reports and are given as appendix No. 51 of this report. The descriptions are in the order of township, range and meridian and are preceded by a list of the townships described.

A map accompanies this report which shows in different colours the surveys performed prior to March 31, 1908, the subdivision surveys between March 31, 1908 and March 31, 1909, and the resurveys during the same period.

## ALLOWANCES AND REMUNERATION FOR SURVEYORS UNDER DAILY PAY.

In order to induce properly educated men to qualify as Dominion land surveyors, so that the Department would have no difficulty in securing the services of competent men to carry on the surveys according to the improved, accurate and scientific methods of the present day, an Order in Council was passed on April 6, 1908, increasing the rates of pay from \$6.50 and \$7.50 per day for ordinary and block outline surveys to \$8 and \$10 per day, respectively. The remuneration of Inspectors of Surveys who are employed continuously was set at \$9 per day while in the field and \$5 per day while engaged at office work. Allowances to surveyors engaged under daily pay were set by Order in Council of April 11, 1905. These allowances were intended only for surveyors in charge of full survey parties and were found insufficient when a surveyor was engaged on a survey where he was accompanied by an assistant only. To meet this case a living allowance of \$2.50 per day each was granted to the surveyor and his assistant by Order in Council of October 16, 1908.

## RATES FOR SUBDIVISION SURVEYS.

Previous to the spring of 1908 the rates for subdivision surveys had been fixed by several Orders in Council. For convenience of reference and to better define the

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different classes of work and thus remove causes for differences of opinion between contractors and the Department these several orders were consolidated by Order in Council of May 12, 1908. No change was made in the rates. The schedule of rates annexed to the Order in Council is as follows:—

*Schedule of rates to be paid for township subdivision surveys of Dominion Lands executed under contract.*

1. Section lines shall be paid for at the rate of three dollars and fifty cents per mile of line surveyed.

2. A further payment at the rate of fifty cents per chain up to ten chains in a section side, shall be made for opening, cutting and blazing the line through woods, windfalls, under-brush or heavy scrub.

3. Any opening, cutting and blazing of the line in excess of ten chains in a section side shall be paid for at the rate of twenty-five cents per chain. If the mileage charged for by the contractor for opening, cutting and blazing of lines exceeds that reported by the Inspector of Surveys, the contractor's account shall be reduced accordingly, the deduction being applied over the whole contract. No deduction, however, shall be made if the contractor's charge does not differ from the Inspector's by more than five per cent. If the lines are not sufficiently blazed a deduction may be made at such rate as the Inspector of Surveys recommends, but not exceeding two dollars per mile.

4. For the interpretation of Clauses 2 and 3, a section line shall mean the distance between two monuments at section corners or the places assigned to such corners, and this distance may include a road allowance.

5. No payment shall be made under the provisions of Clauses 2 and 3 where the line could have been measured without opening and cutting. A strict interpretation shall be given to these clauses and the field notes must show every opening of half a chain or more where no cutting was necessary in order to measure the line.

6. The part of a line chained across a marsh or other body of water, except on the ice, or measured across water by means of a triangulation, shall up to half a mile, be paid for as opening through woods when the body of water is surrounded by continuous woods. When such measurement exceeds a mile in length, one-half the distance shall be paid for as opening through woods. Distance measured by means of improper triangles shall not be paid for.

7. When the side of a section, exclusive of road allowance, is greater than ninety chains or smaller than seventy chains, the number of chains of opening or cutting which may be paid for at the rate of fifty cents per chain shall be increased or reduced in proportion to the length of the section side.

8. Only the lines actually run and marked in the field shall be paid for. Nothing shall be allowed for random and trial lines, bases of triangles and offsets. A single payment only shall be made for the north and south boundaries of townships, although they must always be run twice under the provisions of the Manual of Survey.

9. A further payment at the rate of three dollars per mile shall be made for section lines surveyed over rough or hilly country. A section side shall be classed as rough or hilly when the field notes show that it crosses a ravine not less than 100 feet deep or two ravines not less than fifty feet deep, or that the difference of level between two points of the line not more than half a mile apart exceeds 200 feet, the depths or heights being measured by aneroid barometer. In case the corner of the section falls in the ravine or on the side of the hill, payment shall be made for either of the adjoining sections but not for both.

10. A further payment at the rate of four dollars per mile may be made upon a report of the Inspector of Surveys, concurred in by the Surveyor General, stating that the survey presented unusual difficulties on account of large rivers flowing through



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deep valleys with the surrounding country broken by gullies ; or on account of exceptional extensive and deep marshes. This payment shall not be made for difficulties other than those mentioned or for marshes which have been crossed on the ice. Payment, if made, shall be for the number of miles recommended in the Inspector's report.

11. A further payment at the rate of four dollars per mile shall be made for surveying the meridian outlines of a township when such outlines are included in a subdivision survey contract, but such payment shall not be made for resurveying or retracing lines previously surveyed.

12. Section lines resurveyed or retraced by direction of the Surveyor General, or under the provisions of the Manual of Survey, shall be paid for at the same rate as original section lines in the subdivision of a township, but no payment shall be made for the part of an outline chained under the provisions of the Manual of Survey for testing the chainage. Lines resurveyed or retraced without authority shall not be paid for. The fact that a line is obliterated or that a monument cannot be found shall not be deemed sufficient authority to resurvey or retrace the line.

13. A further payment at the rate of twenty-five cents per pit in prairie, and forty cents per pit in the woods, shall be made for erecting a boundary monument, such payment to cover the cost of planting and marking the post, building the mound and otherwise completing the monument. A witness trench shall be paid for as four pits. A stone mound shall be paid for as four pits in the woods. A long quarter section post planted in a marsh shall be paid for as two prairie pits.

14. Traverses of lakes and rivers and connecting traverses shall be paid for at the rate of eleven dollars per mile, for traverses of lakes and rivers, the distance to be paid for shall be measured along the bank of the lake or river from every point fixed by the survey in a straight line to the next point. Nothing shall be paid for offsets, but one dollar shall be deducted for every offset short of the number required by the Manual of Survey.

15. One dollar shall be paid for every statutory declaration of a settler.

16. A payment at such rate as the Surveyor General may allow, but not exceeding two dollars per mile of township outline or section line surveyed, may be made for the determination of the astronomical direction of the line of the survey.

17. The above allowances shall cover the cost of preparing the returns of the survey.

18. Iron posts used on the survey of Dominion lands will be supplied free of cost at Winnipeg and at every other place where they are kept in stock. Posts not used shall, if not returned to stores, be charged to the surveyor at forty cents each.

19. A deduction at the rate of six cents per cubic foot for deficiency in the size of the pits in excess of a foot and a half per pit shall be made from the payments to survey contractors. Further deductions at such rates as the Inspector of Surveys may recommend, shall be made for deficiencies in survey monuments, whether the deficiency be in the scattering of earth away from the pits, the marking or driving of the posts or in the general character of the monument. These deductions shall be averaged on the monuments examined by the Inspector and shall be applied to the whole contract. Should the total amount of the deductions calculated as above, exceed thirty per cent of the amount allowed for erecting the monuments, or should the Inspector report that the monuments are too unsatisfactory to be accepted, the contractor shall be required to repair and correct them according to the standard required by the Manual of Survey.

20. The lines embraced in any survey under contract must be surveyed by the surveyor in person ; no payment shall be made on such contract work if otherwise performed.

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## SUPPLEMENT TO THE MANUAL OF SURVEY.

In 1892 a fourth edition of the Manual of Instructions for the Survey of Dominion Lands was issued containing thirteen tables specially adapted to the survey of Dominion lands. The fifth and sixth editions issued in 1903 and 1905, respectively, contained only eight tables. The tables omitted were those seldom used and it was thought that when needed they could be referred to in the fourth edition.

The fourth edition having become scarce a reprint of the tables was necessary. The Manual proper, owing to the nature of its contents, has to be revised at frequent intervals and as no change is necessary in the tables it was considered advisable to publish them separately as a supplement. This has been done and the supplement in a convenient form has been issued to all Dominion land surveyors and to a few others closely connected with those surveys. It will not be necessary to publish the tables in future editions of the Manual proper.

The construction and use of the tables are fully explained in the supplement and are further elucidated by means of problems connected with the system of survey.

## MANUAL OF SURVEY.

Some important changes have been made, since the issue of the sixth edition of the Manual in 1905, in the methods of survey and in the rates of remuneration for surveyors under daily pay. A booklet of amendments was issued in 1906 and a circular making a few further amendments was issued in 1908. The sixth edition of the Manual being almost exhausted, it is necessary to prepare another revision. Amendments and improvements have been introduced where necessary and the manuscript is now almost complete. It is expected that the new edition will be ready for distribution during the coming season.

THE BOUNDARY BETWEEN THE PROVINCE OF BRITISH COLUMBIA AND YUKON TERRITORY  
FROM TESLIN LAKE TO TATSHENSHINI RIVER.

The boundary between the province of British Columbia and Yukon Territory is defined by the Imperial British Columbia Act of 1866 (29 and 30 Victoria, Chapter 67) as being the sixtieth parallel of north latitude. For other boundaries of the same kind and particularly in marking the forty-ninth parallel between Canada and United States it was agreed that the term, 'parallel of latitude,' means a line passing through all points of the same astronomical latitude, and having between any two adjoining observed latitudes the curvature of the theoretic parallel.

In the year 1898, with the development of the country adjoining the boundary, questions of jurisdiction between the province and the Dominion arose and a demarcation of the boundary became imperative. In November of that year the Provincial Secretary and Minister of Mines, Victoria, B.C., addressed a communication to the Minister of the Interior, calling attention to the necessity of defining the northerly boundary of British Columbia, more particularly of that portion of country situated between the Pacific coast and Teslin lake, and asking the co-operation of the Dominion Government in order to have this boundary line established. The Minister of the Interior directed that the work of defining the boundary should be proceeded with at once, and this was done without the assistance of the province. It is expected, however, that the Provincial Government will adopt the boundary as established by the Dominion officers.

The boundary has been surveyed from Teslin lake to the west crossing of Tatshenshini river, a distance of one hundred and sixty-five miles. Sixteen points on the boundary were established from astronomical observations for latitude on the sixtieth parallel and these points were joined in adjacent pairs by arcs having the curvature of the theoretic parallel; one hundred and fifty additional monuments were established thereon.

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From Teslin lake to Takhini river, eleven points were established by G. White-Fraser, D.T.S., in 1899 and 1900, by astronomical observations for latitude with a twelve-inch altazimuth instrument, with two micrometer microscopes reading to one second of arc. The probable error in latitude of any of these points is about twenty feet.

From Takhini river to Tatshen-shini river five points were established by J. N. Wallace, D.L.S., in 1907 and 1908, by astronomical observations for latitude with a Troughton and Sims zenith telescope, of twenty-eight-inch focal length, Talcott's method for observing latitude being employed. The probable error in latitude of any of these five points is from six to ten feet.

The intermediate monuments from Teslin lake to Takhini river were established by A. Saint Cyr, D.L.S., in 1899, 1900 and 1901; and those from Takhini river to Tatshen-shini river by J. N. Wallace, D.L.S., in 1907 and 1908.

The method employed in establishing the intermediate monuments between stations fixed by astronomical observations is as follows:—Each latitude station was joined to the next one by a line having the curvature of the theoretic parallel at sixty degrees of north latitude, by running, as a trial line, a series of tangents to the prime vertical circles passing through the initial latitude station, and the offsets to the sixtieth parallel were calculated according to the formula:

$$\text{Offset (to parallel from tangent)} = \frac{D^2 \sin \varphi}{2N \cos \varphi}$$

or  $\log$  of offset (in chains) =  $2 \log D + \log C$ , where  $D$  is the distance in chains measured from the points of tangency of the trial line with the assumed, or theoretic parallel passing through the initial astronomical station, and  $C$  is a constant whose logarithm is 6.4352819.

In closing on an astronomical station the residual offset due to difference in station error of the two latitude stations was distributed proportionately at all the monuments.

Linear measurements along the trial line were made by Mr. Saint Cyr with a Lugeol micrometer, and by Mr. Wallace by triangulation with chained bases.

The monuments consist of an iron post, three feet long and three-quarters of an inch in diameter, driven flush with the ground. This iron post defines the boundary. Its position is shown by a wooden post planted beside it, standing, as a rule, about four and one-half feet out of the ground, and surrounded by a circular cairn of stones, or an earth mound, about seven feet in diameter and four feet high. In some cases, owing to the nature of the ground or for other reasons, the iron post was omitted, and the wooden post defines the boundary. A complete description of each monument was recorded by the surveyor and is shown on the plan of the boundary.

Between monument 118 (station L) on Takhini river, and station T, on Hendon river, a distance of nine miles, no monuments were established, owing to the roughness of this part of the country, over which it was impracticable to run the boundary line.

The wooden posts are marked with the letters B. C. (signifying British Columbia) on the south side, and Y. (signifying Yukon) on the north side. The posts are not numbered on the ground, although a system of consecutive numbers has been adopted to designate the monuments, beginning with No. 1 at Teslin lake and ending with No. 166 at the west crossing of Tatshen-shini river. It is the intention to have them numbered on the ground according to this system in the near future.

The monuments have been established where the boundary intersects the most important lakes, rivers and valleys, such as Teslin lake, Narrows lake, Happy valley, Atlin lake, Taku arm, Windy arm, Bennett lake, Munroe lake, Partridge lake, Primrose river, Takhini river, Hendon river, Kusawa river, Blanchard river, and Tatshen-shini river, and also at intermediate points wherever practicable, the distance between the monuments averaging about one mile. In many places ranges of high mountains

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have been crossed, the highest point of the boundary line being on Mt. Nevin (elevation 7,259 feet).

A plan of the boundary between the province of British Columbia and Yukon Territory at a scale of one mile to an inch is published in connection with this report. The plan shows the boundary as surveyed from Teslin lake to Tatshenshiipi river. The monuments are shown by square black marks and the nature of each monument indicated thus: I.P., W.P.M., signifying iron post together with a wooden post and mound. The monuments established by astronomical observations for latitude are distinguished by letters, in addition to their numbers. The distances between the monuments are shown in chains and decimals. The bearings of the lines joining adjacent monuments are shown to the nearest second, and are referred to the meridian passing through each monument. The topography is shown in the immediate vicinity of the boundary line. Elevations are shown in feet above sea level.

Detailed information regarding the several seasons' surveys, the nature of the country, climate and other miscellaneous data may be found in the reports of G. White-Fraser, D.T.S., and A. Saint Cyr, D.L.S. (Reports of the Department of the Interior, 1900, 1901, 1902), and the reports of J. N. Wallace, D.L.S., for 1907 and 1908 (Reports of the Topographical Surveys Branch, 1907-8 and 1908-9). A few of the photographs taken by the surveyors while working on the boundary accompany this report.

## CORRESPONDENCE.

The correspondence consisted of :

|                           |        |
|---------------------------|--------|
| Letters received. . . . . | 10,592 |
| Letters sent. . . . .     | 13,987 |

## ACCOUNTS.

The accountant's record shows :

|  |           |
|--|-----------|
| Number of accounts dealt with. . . . . | 703       |
| Amount of accounts. . . . .            | \$892,231 |
| Number of cheques forwarded. . . . .   | 3,622     |

## OFFICE STAFF.

The office staff of the Topographical Surveys Branch at Ottawa consists of one hundred and sixty-eight employees. A list of the staff is given as appendix No. 10. There are at present seventeen vacancies, sixteen in the chief draughtman's office and one in the geographer's office.

Many changes took place again during the past year in the personnel of the staff.

The following resigned from the staff of the chief draughtman's office:—

Messrs. J. R. Akins, W. B. Bucknill, P. A. Carson, T. A. Davies, H. S. Day, F. H. Maynard, J. E. Morrier, A. G. Stewart, C. H. Taggart and M. B. Weekes. Messrs. A. S. Cram and C. H. Wilding were transferred to the Land Patents Branch, Messrs. G. A. Grey, J. B. Hutton and S. H. Shore to the Registration Branch and Mr. G. A. Gaudry to the Railway Lands Branch.

Messrs. G. B. Dodge, F. H. Kitto and D. F. Robertson were absent part of the time on surveys in the field.

The following new members were appointed:—Messrs. W. B. Bucknill, M. B. Bonnell, J. P. Cordukes, A. d'Orsonnens, E. J. Ebbs, A. H. Flindt, A. M. Grant, K. D. Harris, J. B. Milliken, J. P. MacMillan, B. E. Norrish, H. Osmond, W. J. Peaker, S. H. Shore, R. S. Strouach and L. N. Wadlin, Mr. H. F. Hayward returned to the staff from the Timber, Grazing and Irrigation Branch where he had been working temporarily.

Mr. W. G. Addison was added to the correspondence staff and Miss M. F. Percival was transferred to the Registration Branch.

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Three new members were appointed to the staff of the geographer's office, viz., Messrs. E. D. Bryant and Thos. Grindlay and Miss M. Stewart. Mr. C. G. Wood died; he had been attached to the staff for five years.

Mr. E. E. Bryce was transferred from the Land Patents Branch to the survey records office. Mr. Mudie of this office resigned.

Mr. H. N. Topley of the photographic office has been transferred.

Messrs. E. B. Burnett and P. Kane were appointed to the lithographic office. Mr. H. G. Grant was employed temporarily for three months during the year.

## CHIEF DRAUGHTSMAN'S OFFICE.

(*P. B. Symes.*)

The changes made by the Civil Service Amendment Act of last year have affected this office to a very great extent. For twenty-five years previous to September 1 last all the draughtsmen had been 'temporary employees' with the single exception of the chief draughtsman, although a number of them spent many years in the office. Many, however, remained a very short time and changes were so frequent that it was a continual problem how to arrange the work to the best advantage. The staff being now included in the permanent organization of the service and their remuneration being adequate it is anticipated that changes will in future be few, and this will no doubt tend towards securing a more competent staff, experience in the office itself being of great importance in a branch like this, where the business differs considerably from that in any other office.

The greater permanence of the staff has already shown results in increased efficiency, the routine of the office running more smoothly and more work being turned out without any increase in the number of draughtsmen which is the same as a year ago. This does not mean that we have sufficient help for keeping up with our requirements; in fact we need a considerable increase, being at present sixteen short of the number estimated as necessary and authorized by Order in Council. We are doing the most pressing work but there is much that ought to be done.

The tendency noted in the last report to occupy much of the time of the draughtsmen in correspondence still continues, about six thousand five hundred letters having been drafted in this part of the branch during the year.

The assistant chief draughtsman superintends the preparation of the instructions for surveyors as to the field work allotted to them and this occupies a large part of his time. The instructions vary with every case and often involve a considerable amount of study and research to provide the necessary information to arrange that the work needed in a certain locality shall be done if possible while a surveyor is in the neighbourhood and to avoid overlapping in the distribution of the field work. On the whole, our system seems to be successful; it is very seldom that any misunderstanding arises with reference to the instructions and very seldom that any surveyor has to complain of any incompleteness or mistake in getting them out.

Reports below from the heads of the different divisions give details as to operations carried on in each in the last twelve months.

## DRAUGHTING OFFICE—FIRST DIVISION—INSTRUCTIONS AND GENERAL INFORMATION.

(*T. E. Brown.*)

Owing to the augmentation of the work in this division the staff has been increased from nineteen to twenty-one employees.

Two employees are engaged in preparing instructions to the surveyors in charge of parties in the field. Instructions were drafted for one hundred and twenty-four survey parties. Before instructions for any particular survey can be intelligently

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compiled, it is necessary to collect all available information as to Dominion land, Indian reserve or other surveys already made in the vicinity: this takes the time of five employees. Nineteen hundred and one sketches and 334 maps and tracings were made to accompany the instructions.

The various office registers, in which a record is kept of the surveys performed each year by each surveyor, and of the progress of each surveyor's work in the field take the whole time of two men. It is very important that these records be carefully and accurately kept, as a slight error might entail difficulties and serious losses to the surveyors as well as errors in the township and other plans compiled in the office. Thirteen hundred and eight progress sketches were received from surveyors in the field, also 673 books of field notes of township surveys, 77 books and 503 plans of miscellaneous surveys, 276 timber reports, 436 statutory declarations of settlers and 11 sheets of observations for magnetic declination. Returns of the surveys of 300 separate blocks of timber berths were also received.

After complete examination 615 books of field notes were placed on record, together with 429 notes and plans of miscellaneous surveys and 436 statutory declarations.

Plans of 609 townships and 14 settlements or townsites, and 48 sectional maps were received from the lithographic office, posted in the registers and distributed.

Preliminary plans were issued for 416 townships, four copies of each being furnished. Two members of the staff are occupied a considerable part of the time in preparing these plans; the remainder of their time is devoted to preparing sketches for instructions.

One employee deals with communications from settlers and others on miscellaneous subjects, answers inquiries from other branches of the Department and prepares descriptions of parcels of land for the purpose of transfers and patents. The number of communications in this connection was 1,270, involving the preparation of 329 sketches, 38 maps and tracings and 463 pages of copies of field notes.

A set of sectional maps on a scale of three miles to the inch is being prepared, showing the closings of township surveys. These maps illustrate in a convenient form all discrepancies in the surveys and enable the officials when drafting instructions to point out to the surveyors irregularities they may expect to find in the surveys on the ground. Two employees have been engaged the whole year on these maps, twenty-three of which have been completed.

A general report of survey operations from 1869 to 1889 was published in the annual report of the Department of the Interior for 1891. Two members of the staff are now working on a similar report embracing operations up to the present time. The need of such data for reference has been felt for a long time, but, owing to the pressure of other work, its compilation has been deferred from year to year. It is hoped to have it ready for publication in the next annual report of this branch.

It is expected that there will be ready for publication in the same report a short history of photo-topographical survey operations in the Rocky mountains from their inception up to the present. Two other members of this division have this work now in hand. There is at present no comprehensive description of these operations, hence it is expected that this compilation will prove a valuable aid in the office as a reference, and will be of value to persons interested in photographic surveying.

Considerable work is involved in the collection of data for the annual reports of the Branch. Descriptions of the townships surveyed have to be compiled from the field notes. The reports of the surveyors on their operations for the season have to be examined and put in shape for publication. The employee who is editing the annual report devotes the whole of his time to it.

The storage vault for the branch is in charge of another member of the first division. The work of keeping in order the thousands of documents stored there keeps him busily occupied most of the time. In addition, he attends to the distribution of stationery, drawing instruments, &c., to the officials of the Branch.

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The Manual of Instructions for the Survey of Dominion Lands was revised in this division. This revision has already been mentioned. The Supplement to the Manual of Surveys was also prepared and proofread in this division.

Four thousand and ninety draft letters and memoranda were written during the year.

## DRAUGHTING OFFICE—SECOND DIVISION—EXAMINATION OF SURVEYORS' RETURNS.

(*T. S. Nash.*)

In this division all returns of surveys of Dominion lands in the provinces of Manitoba, Saskatchewan and Alberta are examined and the plans of the surveys are compiled. The reports of the inspectors of contract surveys are examined; the contractors are notified of any discrepancies and they are given the opportunity to make the necessary corrections on the ground. These reports are used in finally accepting the work and in making up the accounts for surveys performed under contract.

The progress sketches which show the progress of the work in the field and upon which advances to the contractors are made are examined to see that all the work closes within the limits required by the Manual and that all areas made fractional by water are shown. During the past year, 1,166 of these sketches were examined including 360 sketches from inspectors.

Upon being received the final returns are first given a cursory examination, the purpose of which is to detect any serious omissions or discrepancies and if necessary, they are returned to the surveyor for correction. After this the returns of all previous surveys in the township, townsite, or settlement are collected and the compiling of the plan is proceeded with. During the year, 478 subdivision surveys, 370 outline surveys, and 63 miscellaneous surveys were examined and the compiled plans of 591 townships were sent to the draughtsmen. This number included first edition plans of 331 townships which shows the rapid rate at which the country is being opened up. Compiled plans of 13 miscellaneous surveys were also sent to be drafted. While the compiling is being carried on a very careful examination is made of the returns of the new survey and a memorandum of any discrepancies or omissions is sent to the surveyor. During the year 525 such memoranda were sent, 486 answers to memoranda were received and the necessary corrections made in the returns, and 1,240 letters in connection with the work were drafted.

This division also examined plans of 280 road diversions made by the provincial governments of Saskatchewan and Alberta, 76 plans of right-of-way of railways, and plans of survey of 74 timber berths.

## DRAUGHTING OFFICE—THIRD DIVISION—DRAWING FOR REPRODUCTION.

(*C. Engler.*)

The staff of this division is smaller than for two or three years past. The nominal strength is thirteen since September 1 last when the employees were admitted into the service on a permanent footing, as compared with fourteen a year ago, and fifteen the year previous. Since September 1, however, one has been permanently transferred and two temporarily employed in another Branch of the Department, one for over a month, the other for nearly three months; at the time of writing the latter is still there. It is needless to add that under these circumstances it is somewhat difficult to keep up with the work of the division.

Owing to the increased demand for space in the building at the corner of Metcalfe and Slater streets it was deemed advisable to move one of the divisions to the Imperial building on Queen street. As the work of this division is for the most part that of preparing plans for printing and consequently does not involve frequent reference to original plans, field notes and files of correspondence, it was thought that this division

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could be best separated from the others and it was accordingly moved to its present quarters. They are large and well lighted, facts which offset to some extent the disadvantage of being at a distance from the Metcalfe street building.

As said above, the principal work of the division consists in preparing plans for printing. These plans are compiled in the second and fourth divisions. In their compilation the main object is accuracy as to data; no special effort is made to form well made figures or letters, in fact the data are usually put on the plans in ordinary handwriting. In the third division these plans are copied, care being taken to make a neat, well arranged plan with all letters and figures carefully made. At present almost all the letters and figures are stamped on the plans in type, thus securing uniformity.

In 1906 a Pilot printing press 6 x 10½ inches inside chase measurement was purchased in order to print titles, footnotes, &c. When the use of a printing press was first suggested for this work it was feared that it might not prove satisfactory; so in order not to have too large an outlay on what seemed a somewhat doubtful venture, the smallest and least expensive press was purchased. 'Two years' trial proved the press to be very useful and the results fully justified the expenditure, but it has been found to be scarcely large enough for some of the work required. The small press was therefore returned to the makers in part payment for a larger and better one 10 x 15 inches inside chase measurement. An expert printer is in charge; he also looks after all the type, ink, &c., used in connection with stamping plans. He has been kept so busy of late that a 'printer's devil' will doubtless be his next requirement.

Another improvement in the office equipment consists in a larger and better tracing frame. It may be explained that a tracing frame is simply a device to enable the draughtsman to trace out on a blank sheet of paper any plan or drawing to be copied. The credit of designing the new tracing frame belongs largely to Mr. J. E. May. In the frame formerly in use sunlight was reflected so as to pass through the plan and make the lines visible to the draughtsman. There were two objections to this: the frame could not be used to advantage when the day was dark and clouded, and it had to be placed near a window in the best light which, of course, left less good light for the ordinary work of the draughtsmen. The present frame is lighted by a series of six electric lights placed below a sheet of plate glass. Provision is made for ventilating the space around these lights so as not to heat the glass. A hood of black cloth shuts out all light from the room and renders the artificial light more effective. Two slits along the edges of the frame make it possible to trace the largest plan by simply sliding the plan through them and rolling it up as it is traced.

During the year, 612 plans of townships have been prepared for printing, together with 167 plans and drawings of a miscellaneous nature. As indicated in the annual report of 1908 the miscellaneous plans and drawings are of great variety. A mere statement of their number gives no idea of the amount of work involved in their production.

With a view to ascertaining the cost of publication of township plans a statement of the actual time spent in preparing each township plan has been kept. This practice has been followed for about five years. Occasionally the cost of publishing plans of other descriptions has been called for and therefore a statement is now being kept of the time spent in preparing all plans and drawings.

DRAUGHTING OFFICE—FOURTH DIVISION—BRITISH COLUMBIA SURVEYS.

(*E. L. Rowan-Legg.*)

The staff of this division has been engaged in the examination of the returns of subdivision surveys, of mineral claims, of railway rights-of-way and of timber berths in the railway belt. Township and townsite plans for the British Columbia surveys are compiled and the fair copies of such plans for reproduction by photo-zincography



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are compared. Instructions for surveys, together with sketches and other information for the use of surveyors in the field are prepared. Replies are made to requests for information, which frequently involves the preparation of sketches and long searches for data. Preliminary plans, which allow of lands being opened for entry previous to the issue of the official plan, are prepared for lands subdivided in the railway belt.

A large number of the returns of survey of timber berths in the railway belt were examined. The work of this division has been greatly increased, not only by the examination of these returns, which heretofore was made in another branch of this Department, but also by the drafting of letters and memoranda in connection therewith.

Discrepancies having been discovered in some of the old surveys in the vicinity of Kamloops lake, the compiling of the plans of several townships, which were urgently needed, could not be proceeded with until check surveys had been made to locate the cause of the discrepancies. As soon as possible, after the completion of these surveys, the plans were compiled and copies issued.

A resurvey of the townsite of Hope was made by Mr. A. W. Johnson, D.L.S., in 1906, and a plan of the same was then commenced in this office, but could not be completed because it was found that some further surveys and corrections would be required. These were made by Mr. Johnson last year, and the plan was finished and copies were issued in January of this year.

On account of the rough character of the country in the railway belt a survey of the whole of any township is not proceeded with at one time, but section, or quarter section lines are surveyed to govern lands for which there are, or may be applications. All additional surveys which have been made since the issue of the first edition of the township plan are added to the original compiled plan, and copies are issued as a second, third or fourth edition corrected as the case may be.

The work of compiling plans of townships in the railway belt has been much complicated by having to show on them the lands which were disposed of by the Provincial Government, and which, therefore, did not form part of those transferred to the Dominion. As the boundaries of these lands do not coincide with section lines of the Dominion lands system of survey they have to be accurately plotted on the plan so as to allow of the areas of fractional legal subdivisions of adjoining Dominion lands being shown. This adds greatly to the time spent in the work of compiling.

## DRAUGHTING OFFICE—FIFTH DIVISION—MAPPING.

(*J. Smith.*)

The principal occupation of the fifth division is the interminable work of keeping the sectional maps up to date. These maps cover the surveyed area of the fertile belt of the northwest provinces from Lake of the Woods to the Rocky mountains and also the railway belt in British Columbia. Each sheet covers eight townships from south to north and an average of fourteen townships from east to west, thus comprising about one hundred and twelve townships or a little over four thousand square miles or two million five hundred and sixty thousand acres.

Up to the present time seventy-six sheets have been published and the number will be increased as the surveys are extended. No new sheets have been published during the past year but forty-six have been revised, thirty-four of these have been reprinted and the remainder are in the printers' hands and will be issued before long. Apart from the actual drawing and tracing of the sectional maps, a very considerable part of the work is the obtaining of the information required in revising. During the past year eight hundred and fifty-three plans of surveyed trails were obtained from the record office and examined for information, one hundred and fifty-five field books of township and other surveys were also obtained from the record office and used in compiling, besides two hundred and sixty-eight field books which had not yet been placed

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on record. The positions of four hundred and twenty-seven post-offices were ascertained through the Post Office Department, and a large amount of information about new railways and other items had to be collected.

In connection with the Yukon surveys the number of returns received is more than double that of last year, and a more rigid scrutiny of the surveyors' returns has caused a great increase in the correspondence and in the office work generally.

The miscellaneous drawings made by the fifth division consist of a plan of the mouth of Klondike and Bonanza rivers showing the complication of surveys at that point, a small plan of a ford across the Athabaska river, a copy of W. Thibaudeau's plans and profiles of water-powers on the Winnipeg river, a plan of the electoral districts of Yukon Territory, plans of the first system of surveys near Prince Albert and the fifth system near Port Moody, a map of the boundary between the province of British Columbia and Yukon Territory from Teslin lake to Tatshenshini river, and a plan defining the foot of the eastern slope of the Rocky mountains from the international boundary to Peace river. The search for definite information on this last subject and a report thereon entailed the examination of one hundred and five field books besides a large amount of other literature.

One draughtsman resigned his position since the last report but two others were appointed to the staff which now numbers eleven.

DRAUGHTING OFFICE—SIXTH DIVISION—SCIENTIFIC AND TOPOGRAPHICAL WORK.

*(G. Blanchard Dodge.)*

This division was formed during the year and is to consist of thirteen employees. The duties of the division will be the control and supervision of the scientific and topographical part of the surveys.

Almost from the inception of the surveys it has been realized that valuable topographical and scientific information could easily be obtained at a small extra cost by the surveyors who are subdividing Dominion lands. A few attempts were made to collect such information but from motives of economy they were soon discontinued, the work of the surveyors being strictly limited to what was necessary for the purposes of settlement. The value of such information being now better appreciated by the public, the surveys are being made somewhat more elaborate.

As a beginning, surveyors of base lines are now taking levels along the lines. These will be ultimately connected and will form the basis for maps showing the relief of the country. A knowledge of this relief is of the utmost importance in questions of irrigation or drainage, construction of roads, railways or canals, for the classification of agricultural lands and many other purposes.

The field notes of the surveyors contain much topographical information which has never been plotted because the office staff was insufficient; this work will now be taken up and put in shape for publication.

Although the lines of the Dominion Lands System of survey are established upon astronomical bearings, the compass is very useful in exploratory surveys and for work of a like character. Considerable information is gathered by surveyors regarding the declination, inclination and intensity, but the observations have to be co-ordinated and properly recorded. Improvements in the instruments supplied to surveyors will greatly add to the value of the observations.

The preparation of the astronomical field tables and diagrams and the calculations incidental to the business of the topographical surveys have now assumed such proportions that a special staff of mathematical experts has become a necessity. Work of this character will all be done in this division.

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## SURVEY RECORDS OFFICE.

*(C. J. Steers.)*

The rapid increase in the routine work of the office has made it very difficult to get the time needed for readjustment of indexes and general supervision. During the months of the year when work was not so pressing some progress was made on the new loose leaf indexes. The portions being entered first are those which experience has shown most required adjustment.

A new index for field notes of township surveys has also been started and is being worked at as time is available. This index is made necessary as the old one is very congested owing to the smallness of its scale and the increasing numbers of field books affecting many of the townships.

A large portion of one man's time has been taken up supplying information for the sub-agents, chiefly in preparing for them skeleton maps of sub-agencies on a large scale showing the lands disposed of.

The increase in the number of printed and preliminary plans has been so great that it has been found necessary to divide up the work of sending them out; one person now attends to the printed plans and letters, while another has charge of the preliminary plans and letters accompanying them.

A list is now kept of plans asked for which are out of print, so that these plans may be sent to the parties desiring them as soon as the reprints are received.

PHOTOGRAPHIC OFFICE—(*Process Work*).*(H. K. Carruthers.)*

After the clean copy of a plan has been completed it is handed over to the process photographer for reproduction. The plan is photographed on a wet plate and then printed on a zinc plate. From the zinc, the plan is transferred either to stone or to another zinc plate, according as it is to be printed on the flat bed or rotary offset press.

A new copying camera has been installed; it takes plates from 4 x 5 inches to 24 x 34 inches, while the largest size with the old camera was 17 x 20 inches. A great advantage of the new camera is that it is provided with very complete means of adjustment; this will improve, not only the quality of the work but its accuracy.

Corrections to plans have hitherto been made mostly on the lithographic stones or zinc plates; they are now being made as much as possible on the negatives, before printing on zinc. It is found that the corrections are not only more easily made on the negatives, but the work is also finer. The only extra trouble is the striking of a proof from the negative on blue print paper.

The number of negatives made was about 200 in excess of last year.

PHOTOGRAPHIC OFFICE—(*General Work*).*(John Woodruff.)*

During dark days in winter some difficulty has been experienced in handling the large number of silver prints which we were called upon to furnish. To expedite printing, an aristo-electric lamp and cabinet have been procured. The cabinet is revolving; it holds forty 5 x 7-inch frames and twelve 11 x 14-inch frames. In the centre is a powerful arc lamp. The apparatus is a great convenience and there is no longer any delay in printing.

A dry mounting press has been purchased. With it photographs can be mounted on the thinnest mounts without curling. The improvement is particularly manifest in the case of large photographs.

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A considerable part of the chief photographer's time is taken by the work of the Immigration Branch. In this connection, he made two trips during the summer, one to the Niagara district for photographing farms and orchards, and one to the Ontario oil fields for photographing oil wells and plants. He secured a large collection of fine views. He also attended the Terecentenary celebration at Quebec and secured views of the most interesting events.

## LITHOGRAPHIC OFFICE.

*(A. Moody.)*

The rotary offset press mentioned in the annual report for 1907-8 has been installed and is now in operation. It has given some trouble, but it is expected that all the difficulties will soon be overcome and that it will be turning out fine work. It is a fast press and particularly useful in printing large editions.

The machine for graining zinc plates set up at the same time as the rotary press is proving quite satisfactory. By using zinc instead of lithographic stones, plans or maps can be kept on the plates for new issues, the plates being easily stored away. If the plans or maps were on stone, they would have to be cleared away after printing.

A lithographic artist has been added to the staff; when not engaged in preparing lithographic stones or plates, he helps in spotting and making corrections on negatives.

Part of the plant is in the building at the corner of Metcalfe and Slater streets, the other part being in the Imperial building. This division is very inconvenient; moreover, the places are too small and too crowded for working to advantage.

## GEOGRAPHIC BOARD.

*(A. H. Whiteher.)*

The seventh report of the Geographic Board of Canada, being a consolidation of the decisions published in previous reports and bulletins to June 30, 1908, was published and distributed. In addition to the large number issued in 'blue-book' form with other sessional papers of the Government, the Board receives 800 copies which are sent to Dominion and Provincial officials, colleges, school inspectors and libraries, also to geographical societies and map publishers in Canada and elsewhere, and the bulletins containing the decisions published in the *Canada Gazette* are distributed from time to time in like manner.

The regular monthly meetings of the Board have been well attended and special meetings have been held during the year.

Mr. Whiteher, who is a member of the Board and its secretary, has also continued the special work assigned to him as a member of the staff of the Topographical Surveys Branch.

## BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

*(F. D. Henderson.)*

Three meetings of the Board of Examiners were held during the year. The first was a special meeting lasting from May 2 to May 28, 1908, during which examinations were held at Ottawa, Toronto and Calgary. The second one was a special meeting held on July 28, 1908. The third one was the regular annual meeting which began on the second Monday in February, 1909 (February 8), as provided by the Dominion Lands Surveys Act, section 9, and lasted until March 26, 1909. During this meeting examinations were held at Ottawa, Halifax, Toronto, Winnipeg, Calgary, Edmonton and Vancouver.

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At the two examinations (May, 1908, and February, 1909), eighty-eight candidates passed the preliminary examination, thus becoming eligible to serve as articled pupils, twenty-seven candidates passed the final examination for commission as Dominion land surveyor, and one candidate passed the examination for certificate as Dominion topographical surveyor. The names of the successful candidates are as follows :—

## PRELIMINARY EXAMINATION.

Barnes, F. M., St. John, N.B.  
 Banting, E. W., Toronto, Ont.  
 Beale, A. M., Ottawa, Ont.  
 Bennett, G. A., Eden, Ont.  
 Beresford, H. E., Grandview, Man.  
 Berry, E. W., Seaforth, Ont.  
 Bidouze, P., Edmonton, Alberta.  
 Blanchet, G. H., Ottawa, Ont.  
 Boulton, W. J., Wallaceburg, Ont.  
 Bowman, H. D., London, Ont.  
 Brown, E. C., Grenfell, Sask.  
 Buchanan, J. A., Comber, Ont.  
 Calder, J. A., Ashcroft, B.C.  
 Cameron, A., Ottawa, Ont.  
 Cannel, H. W., Ottawa, Ont.  
 Casey, J. M., Ottawa, Ont.  
 Churchill, H. W., Westport, N.S.  
 Cline, C. G., East Aurora, N.Y.  
 Colter, A. A., Keswick, N.B.  
 Dann, E. M., London, Ont.  
 Dawson, F. J., Truro, N.S.  
 de la Condamine, C., High River, Alta.  
 Donnelly, C., Winnipeg, Man.  
 Duff, M. O'R., Hamilton, Ont.  
 Elder, P. M., Ottawa, Ont.  
 Evans, S. L., Corinth, Ont.  
 Ewart, D. M., Ottawa, Ont.  
 Fletcher, J. A., Fletcher, Ont.  
 Glover, A. E., Beaverton, Ont.  
 Graham, D. A., Toronto, Ont.  
 Gray, J. E., Uxbridge, Ont.  
 Hamilton, C. T., Fort William, Ont.  
 Harvey, D. W., London, Ont.  
 Higgins, C. J., Vancouver, B.C.  
 Hobbs, W. E., Winnipeg, Man.  
 Huffman, K., Toronto, Ont.  
 Jackson, W., Toronto, Ont.  
 Johnson, R. H., Toronto, Ont.  
 Johnston, H. F., Toronto, Ont.  
 Jost, L. G., Guysborough, N.S.  
 Lloyd, N. C. A., Schomberg, Ont.  
 Loucks, R. W. E., Delisle, Sask.  
 Macdonald, G. A., Muirkirk, Ont.  
 Manny, D. E., Beauharnois, P.Q.  
 Martindale, E. S., Kingsmill, Ont.  
 Martin, W. H., St. Thomas, Ont.

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Martyn, O. W., Mitchell, Ont.  
 Meader, C. H., Toronto, Ont.  
 Mitchell, A. B., Toronto, Ont.  
 Munro, F. V., Chatham, Ont.  
 Murdock, C. R., Toronto, Ont.  
 McCusker, K. F., St. Louis de Gonzague, P.Q.  
 McGarry, P. J., Merritton, Ont.  
 McKenzie, M., Lake Megantic, P.Q.  
 McLean, D. L., Ottawa, Ont.  
 McMaster, W. A. A., Palmerston, Ont.  
 McRoberts, A. A., Pontypool, Ont.  
 Narraway, A. N., Ottawa, Ont.  
 Neelands, R., Hamiota, Man.  
 Neville, E. A., Toronto, Ont.  
 Patterson, E. B., Toronto, Ont.  
 Peckover, H. J., Toronto, Ont.  
 Peters, F. H., Ottawa, Ont.  
 Pounder, J. A., Toronto, Ont.  
 Purser, R. C., Windsor, Ont.  
 Ransom, J. T., Toronto, Ont.  
 Redfern, C. R., Toronto, Ont.  
 Ritson, C. W., Edmonton, Alberta.  
 Robertson, E. D., Ottawa, Ont.  
 Robinson, W. A., Winnipeg, Man.  
 Roe, B. J., Ottawa, Ont.  
 Seibert, F. V., Southampton, Ont.  
 Sharpe, G. P., Agassiz, B.C.  
 Soars, N., Edmonton, Alberta.  
 Stewart, N. C., Nelson, B.C.  
 Stirrett, G. P., Petrolia, Ont.  
 Tate, H. W., Wimbledon, Eng.  
 Tremblay, A. J., Edmonton, Alberta.  
 Theriault, L. L., Fredericton, N.B.  
 Underwood, J. A., Lakelet, Ont.  
 Van Skiver, L. A., Fish Lake, Ont.  
 Walcott, W. H., Montreal, P.Q.  
 Walker, C. M., Guelph, Ont.  
 Warren, J. S., Strathcona, Alberta.  
 Waugh, B. W., Chicago, Ill.  
 Wilson, W. S., Sault Ste. Marie, Ont.  
 Wing, D. O., Berlin, Ont.

## FINAL EXAMINATION.

Ashton, A. W., Ottawa, Ont.  
 Baker, M. H., St. Thomas, Ont.  
 Campbell, A. J., Toronto, Ont.  
 Campbell, A. S., Kingston, Ont.  
 Chilver, H. L., Walkerville, Ont.  
 Christie, U. W., Ottawa, Ont.  
 Clunn, T. H. G., Ottawa, Ont.  
 Cochrane, M. F., Ottawa, Ont.  
 Cumming, A. L., Ottawa, Ont.  
 Cummings, A., Fernie, B.C.

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Dennis, E. M., Ottawa, Ont.  
 Dodge, G. B., Ottawa, Ont.  
 Johnson, P. N., Edmonton, Alberta.  
 Lang, J. L., Toronto, Ont.  
 McCallum, G. H., Ottawa, Ont.  
 McCaw, R. D., Welland, Ont.  
 McFarlane, J. B., Toronto, Ont.  
 Rannie, J. L., Ottawa, Ont.  
 Rice, F. W., Ottawa, Ont.  
 Rolfson, O., Walkerville, Ont.  
 Scott, W. A., Galt, Ont.  
 Summers, G. F., Winchester, Ont.  
 Sykes, F. H., Toronto, Ont.  
 Tremblay, A., Quebec, P.Q.  
 Westland, C. R., Ottawa, Ont.  
 Williams, G. L., Vancouver, B.C.  
 Wilson, N. D., Toronto, Ont.

## D. T. S. EXAMINATION.

McColl, G. B., Winnipeg, Man.

Oaths of office and allegiance and bonds for the sum of one thousand dollars each, as required by section 25 of the Dominion Lands Surveys Act, were received from twenty-five candidates who had previously passed the examination for commission as Dominion land surveyor.

Twenty-three commissions as Dominion land surveyors were issued, as follows:—

Ashton, A. W., Ottawa, Ont.  
 Baker, M. H., St. Thomas, Ont.  
 Campbell, A. S., Kingston, Ont.  
 Christie, U. W., Chesley, Ont.  
 Clunn, T. H. G., Ottawa, Ont.  
 Cochrane, M. F., Ottawa, Ont.  
 Dodge, G. B., Ottawa, Ont.  
 Lang, J. L., Toronto, Ont.  
 McAuslan, H. J., Euphrasia, Ont.  
 McCaw, R. B., Welland, Ont.  
 McFarlane, J. B., Toronto, Ont.  
 Mitchell, B. F., Hamilton, Ont.  
 Rannie, J. L., Ottawa, Ont.  
 Rinfret, C., St. Stanislas, P.Q.  
 Robinson, E. W. P., Victoria, B.C.  
 Rolfson, O., Walkerville, Ont.  
 Scott, W. A., Galt, Ont.  
 Soars, H. M. R., Edmonton, Alberta.  
 Steele, I. J., Ottawa, Ont.  
 Stewart, A. S., Edmonton, Alberta.  
 Sykes, F. H., Toronto, Ont.  
 Williams, G. L., Vancouver, B.C.  
 Wilson, N. D., Toronto, Ont.

A certificate as Dominion topographical surveyor was issued to G. B. McColl, D.L.S., Winnipeg, Manitoba.

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Every Dominion land surveyor is required to have in his possession a subsidiary standard of length (D.L.S. Act, section 35). Eighteen such standards were issued by the Secretary, and one surveyor reported that he had secured a standard from the estate of a deceased surveyor. A list of surveyors who have been furnished with standard measures up to March 31, 1909, will be found in Appendix No. 11.

The correspondence of the Board was as follows:—

|                           |       |
|---------------------------|-------|
| Letters received. . . . . | 1,717 |
| Letters sent. . . . .     | 1,196 |

Circular letters, pamphlets and parcels sent, 600 (approx).

The questions put at the examination in February, 1909, are submitted as Appendix No. 12.

At the special meeting in May, 1908, 62 candidates presented themselves for the full preliminary examination, 15 for the limited, 18 for the final, and 1 for the examination for certificate as Dominion topographical surveyor. The affidavits and certificates of the final candidates were examined and the answers of all the candidates were read.

The meeting of July 28 dealt with a communication to the Board relative to a survey in the Yukon Territory.

At the regular meeting in February, 1909, 126 candidates presented themselves for the full preliminary examination, 21 for the limited preliminary, 34 for the final, and 2 for the D.T.S. The affidavits and certificates of the final candidates were examined and the answers to the examination papers were read. Several communications were dealt with, and it was decided that when a surveyor obtains a standard measure from any one except the Secretary, he shall at once submit it to the Secretary to be tested.

Applications having been received from several candidates for an examination in May, the necessary question papers were prepared before adjournment.

The number of candidates examined during the year was 279 as compared with 161 during the previous year.

Mr. F. D. Henderson is the Secretary of the Board.

#### APPENDICES.

The following schedules and statements are appended:—

No. 1. Schedule of surveyors employed and work executed by them from April 1, 1908 to March 31, 1909.

No. 2. Schedule showing for each surveyor employed from April 1, 1908, to March 31, 1909, the number of miles surveyed, of township section lines, township outlines, traverses of lakes and rivers and resurvey; also the cost of the same.

No. 3. List of lots in the Yukon Territory, surveys of which have been received from April 1, 1908, to March 31, 1909.

No. 4. List of miscellaneous surveys in the Yukon Territory returns of which have been received from April 1, 1908, to March 31, 1909.

No. 5. Statement of work executed in the office of the chief draughtsman.

No. 6. List of new editions of sectional maps issued from April 1, 1908, to March 31, 1909.

No. 7. Statement of work executed in the survey records office from April 1, 1908, to March 31, 1909.

No. 8. Statement of work executed in the photographic office from April 1, 1908, to March 31, 1909.

No. 9. Statement of work executed in the lithographic office from April 1, 1908, to March 31, 1909.



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No. 10. List of employees of the Topographical Surveys Branch at Ottawa giving the name, classification, duties of office and salary of each.

No. 11. List of Dominion land surveyors who have been supplied with standard measures.

No. 12. Examination papers of the board of examiners for Dominion land surveyors.

Nos. 13 to 50. Reports of surveyors employed.

No. 51. Descriptions of surveyed townships submitted by Dominion land surveyors from April 1, 1908, to March 31, 1909.

NOTE.—Appendices Nos. 12 to 51 appear in the report of the Topographical Surveys Branch in monograph form.

## MAPS.

The following maps accompany this report :—

Map showing surveys and resurveys made from April 1, 1908, to March 31, 1909.

Map of the boundary between British Columbia and Yukon Territory.

Maps accompanying reports of surveyors.

NOTE.—The above maps accompany the report of the Topographical Surveys Branch in monograph form.

I have the honour to be, Sir,

Your obedient servant,

E. DEVILLE,

*Surveyor General.*

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# TOPOGRAPHICAL SURVEYS BRANCH.

## SCHEDULES AND STATEMENTS.

### APPENDIX No. 1.

SCHEDULE of Surveyors employed and work executed by them, from April 1, 1908, to March 31, 1909.

| Surveyor.          | Address.                 | Description of Work.   |
|--------------------|--------------------------|--|
| Aylsworth, C. F.   | Madoc, Ont.              | Partial subdivision of township 22, range 4; retracement and restoration survey of townships 16, range 1, and 11, range 7; partial retracement and restoration of townships 12, range 5, 16, range 7, and 17, range 8; all east of the principal meridian. Retracement and restoration survey of township 13, range 3, west of the principal meridian.   |
| Baker, J. C.       | Vermilion, Alta.         | Contract No. 7 of 1908; subdivision of townships 53, 55, and 56, range 14, townships 52, 55, and 55, range 15, and townships 52, ranges 16 and 17; the northerly one-third of townships 54, ranges 14 and 15, and the southerly one-third of township 53, range 16, also the east outline of township 56, range 16; all west of the fifth meridian.  |
| Beatty, David.     | Parry Sound, Ont.        | Survey of the east and south boundaries of Porcupine forest reserve in townships 39, ranges 29, 30, 31 and 32, township 40, range 28, and township 41, range 27 west of the principal meridian.  |
| Belanger, P. R. A. | Ottawa, Ont.             | Completion of inspection of contract No. 27 of 1906; inspection of contracts Nos. 14, 26, 30 and 32 of 1907, and partial inspection of contracts Nos. 17 and 20 of 1908; traverse of Winnipeg river in townships 13 and 14, ranges 12 and 13, and in townships 15 and 16, ranges 14 and 15; traverse of Pinawa channel in township 14, range 12; traverse of islands and lakes and verification surveys in townships 15, ranges 14 and 15; all east of the principal meridian. |
| Bingham, E. R.     | Fort William, Ont.       | Survey of a parcel of land between Blocks A and B of The Pas Indian reserve and extending southerly a distance of one mile from the Saskatchewan river.  |
| Bolton, Lewis.     | Listowel, Ont.           | Contract No. 2 of 1908; subdivision of townships 31 and 32, ranges 14, 15 and 16, and townships 28, 29, 30, 31 and 32, range 17; all west of the fourth meridian.  |
| Bourgault, C. E.   | St. Jean Port Joli, P.Q. | Retracement and correction surveys in townships 11, 19 and 20, range 2; 9 and 30, range 3; 9, range 4; 21 and 22, range 5; 14, range 9; 17, 20 and 21, range 13; 20 and 21, range 14; 16, range 15, and 29, range 17; survey of Loukhobor village in township 31, range 3; retracement of township 20, range 4, and  |

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## APPENDIX No. 1—Continued.

## SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—Continued.

| Surveyor.              | Address.                 | Description of Work.   |
|------------------------|--------------------------|--|
|                        |                          | partial retracement of townships 21 and 23, range 8; all west of the second meridian. Partial retracement of township 16, range 28, west of the principal meridian.  |
| Bourgeault, A. . . . . | St. Jean Port Joli, P.Q. | Contract No. 5 of 1908; complete subdivision of townships 20, ranges 8 and 9, and partial subdivision of township 18, range 11; all east of the principal meridian.  |
| Bray, Edgar. . . . .   | Oakville, Ont. . . . .   | Contract No. 6 of 1908; subdivision of township 38, range 2; partial subdivision of townships 38, ranges 1 and 3; the east outlines of townships 39 and 40, ranges 2 and 3, and traverse of lakes, in township 37, range 2; all west of the second meridian.   |
| Carson, P. A. . . . .  | Ottawa, Ont. . . . .     | Triangulation surveys in British Columbia in connection with the Trigonometrical Section of the Topographical Survey of Canada. Subdivision and traverse in townships 26 and 27, range 26, west of the fifth meridian.   |
| Cautley, R. H. . . . . | Edmonton, Alta. . . . .  | Contract No. 13 of 1908; subdivision of townships 5 and 6, ranges 4, 5, 6 and 7; townships 7, 8 and 9, ranges 3, 4, 5 and 6; townships 10, ranges 3 and 6, and townships 6, ranges 2 and 3; all west of the third meridian.  |
| Cautley, R. W. . . . . | Edmonton, Alta. . . . .  | Contract No. 29 of 1908; completion of subdivision of townships 31, range 15, 32, range 18, and 34, range 19; subdivision of townships 31, range 16; 32, ranges 15, 16 and 17, 33, ranges 16, 17 and 18, 34, range 18, and 35, ranges 18, 19 and 20; partial resurvey of township 34, range 20; traverses in townships 30 and 31, range 17, and 33, range 19; survey of the east outlines of townships 36, ranges 20 and 21; all west of the principal meridian. |
| Christie, Wm. . . . .  | Chesley, Ont. . . . .    | Survey of portions of the seventh base across ranges 9 and 10; resurvey of the eighth base across ranges 11 and 12; resurvey of the ninth base across ranges 15, 16, 17 and parts of ranges 14 and 18; retracement of the ninth base across ranges 10, 11, 12, 13 and part of 14; survey of the east outlines of townships 29, 30 and part of 31, range 10, 31 and 32, range 16, and 33, 34, 35 and 36, range 17; all west of the principal meridian.            |
| Coté, J. L. . . . .    | Edmonton, Alta. . . . .  | Contract No. 21 of 1908; subdivision of townships 64, ranges 19 and 20, township 66, range 18, and townships 67, ranges 16, 17, 19, 20, 21, 22 and 23; survey of the east outlines of townships 63, ranges 19 and 20, townships 65, 66 and 68, range 17, and of townships 65 and 68, range 18; all west of the fourth meridian.  |
| Davies, T. A. . . . .  | Ottawa, Ont. . . . .     | Retracement of the fifth meridian from the north-east corner of section 24, township 4, to the third base; partial retracement of townships 5, 6, 7 and 8, range 1; partial subdivision of townships 8, 9, 10, 12 and 13, range 3, and of township 8, range 4; all west of the fifth meridian. Partial retracement of townships 5, 6, 7, 8 and 9, range 30, and township 9, range 29; all west of the fourth meridian.   |

9-10 EDWARD VII., A. 1910

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

| Surveyor.                           | Address.          | Description of Work.   |
|-------------------------------------|-------------------|--|
| Deans, W. J.                        | Brandon, Man.     | Part subdivision of townships 23, ranges 20 and 21, townships 29 and 30, range 23, township 26, range 24, and township 23, range 26; miscellaneous retracement and correction survey in townships 23, range 10, 22 and 23, range 11, 28, range 18, 30 and 31, range 21, 22, range 27, and 24, range 30, west of the principal meridian.  |
| Driscoll, A.<br>(See A. G. Stacey.) | Edmonton, Alta.   | Contract No. 8, 1908; subdivision of townships 1 and 2, ranges 2, 3 and 4, townships 3, ranges 7, 8 and 9, townships 4 and 5, ranges 2, 3, 7, 8 and 9; survey of the east outlines of townships 3, ranges 2, 3, 4 and 5; all west of the fourth meridian.  |
| Dumais, P. T. C.                    | Hull, Quebec      | Contract No. 33 of 1907; subdivision of townships 27, 28 and 29, ranges 12 and 13, and township 30, range 13; all west of the principal meridian.  |
| Edwards, Geo.                       | Ponoka, Alta.     | Contract No. 25 of 1908; subdivision of townships 52, ranges 7 and 8; partial subdivision of township 52, range 9; all west of the fifth meridian.   |
| Fairchild, C. C.                    | Edmonton, Alta.   | Contract No. 16 of 1908; subdivision of townships 61, ranges 6 and 7, townships 62, ranges 4, 5, 6 and 7; partial subdivision of township 62, range 1; survey of the east outlines of townships 63 and 64, ranges 4, 5, 6, 7 and 8; all west of the fifth meridian. Partial subdivision of township 62, range 27, west of the fourth meridian.   |
| Farncomb, A. E.                     | Lacombe, Alta.    | Contract No. 12 of 1908; subdivision of townships 52, ranges 21, 22, 23 and 24, townships 53, ranges 21, 22 and 23; all west of the fifth meridian.  |
| Fawcett, A.                         | Gravenhurst, Ont. | Contract No. 26 of 1908; subdivision of townships 50, 51 and 52, ranges 12 and 13, and township 50, range 14; survey of east outline of township 49, range 12; all west of the second meridian.  |
| Fawcett, A.                         | Niagara Falls     | Retracement and restoration survey of the fourth meridian through townships 6 to 26 inclusive. Miscellaneous surveys in townships 10 and 11, range 22, west of the fourth meridian; miscellaneous surveys in townships 12 and 28, range 1, 50, range 6, 35, range 13, 14 and 15, range 24, and 14, range 30, all west of the third meridian. Miscellaneous surveys in townships 23 range 13, 25 range 22, 50 range 26, and 41 range 27; all west of the second meridian. |
| Fontaine, L. E.                     | Levis, Quebec     | Inspection of contracts Nos. 29 and 31 of 1907, and completion of the inspection of contracts Nos. 2, 16 and 24 of 1907; inspection of contracts Nos. 7, 18 and 27 of 1908; miscellaneous surveys in townships 55, range 5, and 57, range 7, west of the fifth meridian.   |
| Green, T. D.                        | Ottawa, Ont.      | Survey of the east outlines of townships 43 and 44, ranges 19 and 20, west of the fifth meridian; a traverse to locate coal lands on the south branch of Brazeau river.  |
| Hawkins, A. H.                      | Listowel, Ont.    | Survey of the twelfth base across ranges 15 to 19 inclusive; survey of the thirteenth base across ranges 24 to 28 inclusive; partial subdivision of township 49, range 27; sur-  |

SESSIONAL PAPER No. 25

APPENDIX No. 1—Continued.

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—Continued.

| Surveyor.        | Address.         | Description of Work.   |
|------------------|------------------|--|
|                  |                  | vey of the east outline of township 50 and part of east outline of township 49, range 27, all west of the fifth meridian; survey of the thirteenth base across part of range 1, west of the sixth meridian.  |
| Heathcott, R. V. | Edmonton, Alta.  | Contract No. 28 of 1908; subdivision of townships 55 and 56, ranges 12 and 13, and partial subdivision of townships 54, ranges 12 and 13; all west of the fifth meridian.<br>Contract No. 31 of 1907; subdivision of townships 52 and 53, ranges 18, 19 and 20, west of the fifth meridian.  |
| Holcroft, H. S.  | Toronto, Ont.    | Subdivision of townships 81, ranges 24, 25 and 26, and township 82, range 24; resurvey of the east outline of township 82, range 24, and of the north outlines of townships 80, ranges 24, 25 and 26; all west of the fifth meridian; resurvey of the sixth meridian through township 81; survey of an addition to Shaftsbury settlement.  |
| Hopkins, M. W.   | Edmonton, Alta.  | Contract No. 19 of 1908; subdivision of townships 61, 62 and 63, range 1, townships 61, 62, 63 and 64, range 2, townships 61 and 62, ranges 3, 4, 7, 8, 9 and 10; survey of the east outlines of townships 63 and 64, ranges 8 and 10; all west of the fourth meridian.  |
| Hubbell, E. W.   | Ottawa, Ont.     | Inspection of contracts Nos. 6, 7, 11, 13, 27 and 28 of 1907, and contracts Nos. 6 and 11 of 1908; completion of inspection of contracts Nos. 15, 20 and 21 of 1907; mounding the east boundary of townships 39 and 40, range 17, and correction survey in township 39, range 16, west of the second meridian; traverse in township 52, range 4, west of the third meridian.   |
| Johnson, A. W.   | Kamloops, B.C.   | Subdivision in townships 5 and 12, range 27, west of the sixth meridian, and in township 21, E.C.M.; resurvey in townships 7, 8, 9 and 11, range 22, in townships 3, 4, 5, 6, 9, 10, 11 and 12, range 23, west of the sixth meridian, and in township 26, E.C.M.; traverse survey in township 5, range 26, and in township 14, range 27, west of the sixth meridian; subdivision and resurvey in township 2, range 29, west of the sixth meridian, and in townships 3 and 4, range 5, west of seventh meridian; traverse and resurvey in townships 12, 13 and 16, E.C.M.; traverse and subdivision in townships 6 and 7, range 26, west of the sixth meridian; traverse, subdivision and resurvey in township 15, range 27, and townships 3, ranges 29 and 30, west of the sixth meridian; two triangulations from the Canadian Pacific railway to the boundary of the railway belt. |
| Kimpe, M.        | Edmonton, Alta.  | Contract No. 18 of 1908; subdivision of townships 49, 50 and 51, range 7, and townships 55 and 56, ranges 9, 10 and 11, and completion of the subdivision of township 54, range 11; all west of the fifth meridian.  |
| Kirk, J. A.      | Revelstoke, B.C. | Partial subdivision of townships 23, ranges 2 and 5, west of the sixth meridian.   |

9-10 EDWARD VII., A. 1910

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

| Surveyor.         | Address.             | Description of Work.  |
|-------------------|----------------------|---|
| Kitto, F. H.      | Ottawa, Ont.         | Contract No. 11 of 1908; subdivision of townships 52, ranges 3 and 4, west of the third meridian.   |
| Knight, R. H.     | Edmonton, Alta.      | Contract No. 14 of 1908; subdivision of townships 61, 62 and 63, ranges 23 and 24, and township 65, range 21; all west of the fourth meridian.  |
| Lohergan, G. J.   | Buckingham, Que.     | Inspection of contracts Nos. 4 and 31 of 1907, and of contracts Nos. 2, 10, 14, 16, 21 and 23 of 1908; restoration surveys in townships 54 and 55, ranges 20 and 21, and miscellaneous surveys in township 62, range 12, township 61, range 13, townships 52, ranges 17 and 16, townships 64 and 65, range 21, township 50, range 26, and townships 51 range 25, 26 and 27; all west of the fourth meridian. Miscellaneous surveys in township 59, range 4, west of the fifth meridian. |
| McFarlane, W. G.  | Toronto, Ont.        | Contract No. 1 of 1908; subdivision of townships 7, 8, 9, and 10, ranges 7, 8, 9, 10, 11 and 12, and townships 5 and 6, range 8; survey of the east outlines of townships 5 and 6, ranges 10, 11, 12 and 13; all west of the third meridian.  |
| McFee, A.         | Red Deer, Alta.      | Survey of the boundaries of Buffalo Park reserve through townships 42 and 43, range 6, 42, 43 and 41, ranges 7 and 8, and township 43, range 9, west of the fourth meridian.  |
| McGrandle, H.     | Wetaskiwin, Alta.    | Contract No. 10 of 1908; subdivision of townships 60, ranges 19, 20, 21 and 22, township 59, range 21, and part of township 60, range 18 all west of the fourth meridian.   |
| McMillan, Geo.    | Ottawa, Ont.         | Resurvey of township 49, range 25, west of the second meridian; resurvey of townships 42, 43 and 41, range 1, west of the third meridian, including a resurvey of St. Laurent settlement; partial resurvey of township 35, range 5, west of the third meridian.   |
| Miles, G. F.      | Toronto, Ont.        | Inspection of contracts Nos. 1, 3, 8, 9, 13 and 15 of 1908; retracement and restoration survey of townships 23, ranges 1 and 4, and township 24, ranges 2, 3 and 4; miscellaneous surveys in townships 23, range 2, and 18, range 14; all west of the third meridian; miscellaneous surveys in township 1, range 12, township 19, range 29, and township 18, range 30; all west of the second meridian.   |
| Molloy, John      | Winnipeg, Man.       | Contract No. 21 of 1908; subdivision of townships 9 and 10, ranges 14, 15 and 16, and township 10, range 13; all east of the principal meridian.  |
| Montgomery, R. H. | Prince Albert, Sask. | Miscellaneous surveys in townships 43 and 44, range 8, 43, range 9, 48, range 13, and 51, ranges 14 and 15, west of the third meridian, and in township 42, range 24, west of the second meridian.<br>Contract No. 4 of 1908; subdivision of townships 51 and 52, ranges 14 and 15, townships 51, ranges 16, 17 and 18, and partial subdivision of township 50, range 14, all west of the second meridian.  |

## SESSIONAL PAPER No. 25

## APPENDIX No. 1—Continued.

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—Continued.

| Surveyor.       | Address.         | Description of Work.  |
|-----------------|------------------|---|
| Morrier, J. E.  | Ottawa, Ont.     | Survey of Churchill townsite.   |
| Ord, L. R.      | Calgary, Alta.   | Contract No. 30 of 1908; subdivision of townships 32, range 7, 31 and 32, range 8, 30 and 31 range 9, and townships 29, 30 and 31, range 10; survey of the east outlines of townships 29, range 9, and 32, range 11; all west of the principal meridian.  |
| Plunkett, T. H. | Salmon Arm, B.C. | Partial subdivision of townships 26, range 19, 26 and 27, range 21, 26 and 28, range 22, 28, range 23, 21, range 27, and township 21, range 28, west of the fifth meridian; partial subdivision of township 23, range 2, west of the sixth meridian; partial subdivision and resurvey of township 23, range 28, west of the fifth meridian; traverse in township 27, range 22, and township 20, range 29, west of the fifth meridian; traverse in township 20, range 1, west of the sixth meridian.   |
| Ponton, A. W.   | Macleod, Alta.   | Survey of the fifth meridian from township 85 to township 107 inclusive.  |
| Reilly, Wm. R.  | Regina, Sask.    | Retracement and restoration survey in townships 46, ranges 21 and 22, townships 47a, ranges 24 and 25, and township 49, range 23; partial retracement and restoration survey of townships 45 and 49, range 21, townships 44, 45 and 49, range 22, and townships 46, ranges 23 and 24; traverse in township 42, range 27; all west of the second meridian.   |
| Robinson, E. W. | Chase, B.C.      | Partial subdivision of township 23, range 5, townships 21 and 23, range 7, and township 22, range 8; traverse survey in township 23, range 4; subdivision and traverse in township 23, range 2; subdivision and resurvey in township 22, range 6; traverse, subdivision and resurvey in township 23, range 6, and township 22, range 7; all west of the sixth meridian.   |
| Ross, Jos. E.   | Kamloops, B.C.   | Partial subdivision in townships 20 and 21, range 12, townships 16 and 23, range 22, townships 20 and 21, ranges 23 and 24, and township 18, range 25; partial resurvey of townships 18 and 19, range 17, and townships 21, ranges 20 and 21; traverse, subdivision and resurvey in township 18, range 16, townships 19, ranges 12, 14, 15, 16 and 24, townships 20, ranges 13, 15, 16, 19 and 21, and township 22, range 17; subdivision and traverse in township 15, range 22, township 16, range 26, township 19, range 13, township 20, range 21, and township 23, range 23; subdivision and resurvey in township 20, range 14, township 22, range 21, and townships 17, 18 and 19, range 25; all west of the sixth meridian. |
| Roy, Geo. P.    | Quebec.          | Contract No. 27 of 1908; subdivision of townships 57, ranges 10 and 11, and township 58, range 11; all west of the fifth meridian.  |
| Saint Cyr, A.   | Ottawa, Ont.     | Survey of the sixth meridian through townships 52, 51, 48 and part of 47; survey of the fifteenth base west of the fifth meridian across ranges 24, 23, 22, 21 and part of range 20.  |

9-10 EDWARD VII., A. 1910

## APPENDIX No. 1—Continued.

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—Continued.

| Surveyor.  | Address.        | Description of Work.   |
|--|-----------------|--|
| Saint Cyr, J. B.   | Montreal.       | Subdivision of townships 80, ranges 3 and 4; survey of the east outlines of townships 77, 78 and 79, range 5, the south outline of township 79, range 3, and the north outline of township 78, range 4; all west of the sixth meridian; survey of Dunvegan settlement in township 80, range 4, west of the sixth meridian, and of an addition to Peace River Landing settlement in township 83, range 21, west of the fifth meridian.  |
| Saunders, B. J.  | Edmonton, Alta. | Survey of the eleventh base through ranges 8 to 18 inclusive, and part of range 19, west of the fifth meridian.  |
| Selby, H. W.   | Toronto, Ont.   | Subdivision of townships 73 and 74, range 10, and township 74, range 13; partial subdivision of townships 72, ranges 3, 5, 6, 9 and 10, townships 73, ranges 4, 5, 6, and 11, township 74, range 9, township 80, range 19, and townships 81, ranges 19 and 20; survey of the east outline of township 73, range 13, and part of the east outline of township 74, range 12; all west of the fifth meridian; retracement of the Hudson's Bay Company reserve at Lesser Slave lake. |
| Seymour, H. L.   | Edmonton, Alta. | Contract No. 29 of 1907; subdivision of townships 44 and 47, range 4, townships 48 and 49, range 5, and township 49, range 6; partial resurvey of township 43, range 4; survey of the east outlines of townships 45 and 46, range 5; all west of the fifth meridian.<br>Contract No. 22 of 1908; subdivision of townships 45 and 46, ranges 4, 5 and 6; survey of the east outlines of township 47, range 6, and townships 47 and 48, range 7; all west of the fifth meridian.   |
| Stacey, A. G.  | Ottawa, Ont.    | Contract No. 8 of 1908; subdivision of townships 4 and 5, ranges 4 and 5; all west of the fourth meridian.   |
| (Deceased, balance of contract performed by A. Driscoll, D.L.S.) |                 |  |
| Steele, I. J.  | Ottawa, Ont.    | Contract No. 15 of 1908; subdivision of townships 1, 2, 3 and 4, ranges 19, 20, 21 and 22, townships 2 and 3, ranges 23, 24, 25 and 26, and township 2, range 27; survey of the east outlines of townships 1, ranges 24, 25, 26, 27 and 28, and the south outlines of townships 1, ranges 23, 24, 25, 26 and 27; partial resurvey of the south outline of township 1, range 18; all west of the second meridian.   |
| Talbot, A. C.  | Calgary, Alta.  | Survey of villa lots at lake Minnewanka; survey of a road from Laggan to lake Louise; partial subdivision of township 28, range 16, west of the fifth meridian.  |
| Teasdale, C. M.  | Concord, Ont.   | Contract No. 26 of 1907; subdivision of townships 27 and 28, ranges 10 and 11, west of the principal meridian.<br>Contract No. 20 of 1908; subdivision of townships 25, ranges 3, 4, 5, 6 and 7, and township 26, range 7; all west of the principal meridian.   |
| Thibaudeau, W.   | Ottawa, Ont.    | Preliminary exploration and hydro-topographic surveys on St. Mary, Waterton, Southfork and Crowsnest rivers, and on Oil Pass and Tib creeks; preliminary explorations on Belly, Oldman and Livingstone rivers, and on Pincher, Lee, Mills, Gold and Blairmore creeks.  |



## SESSIONAL PAPER No. 25

## APPENDIX No. 1—Continued.

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—Continued.

| Surveyor.      | Address.          | Description of Work.  |
|----------------|-------------------|---|
| Tyrrell, J. W. | Hamilton, Ont.    | Contract No. 17 of 1908; subdivision of townships 25 and 28, range 1, east of the principal meridian; subdivision of townships 25, 26, 27 and 28, range 1, and townships 25, 26 and 27, range 2; survey of east outlines of township 28, range 3; all west of the principal meridian.   |
| Waddell, W. H. | Hamilton, Ont.    | Contract No. 23 of 1908; subdivision of townships 63 and 64, range 13, townships 63, 64 and 65, ranges 14 and 15; all west of the fourth meridian.  |
| Waldron, John. | Moosejaw, Sask.   | Contract No. 3 of 1908; subdivision of townships 4, 5, 6 and 7, range 20, townships 5, ranges 21 and 22, townships 5 and 6, range 23, townships 1, 2, 3 and 4, ranges 26 and 27, and townships 2, 3 and 4, range 30; completion of subdivision of townships 6 and 7, ranges 21 and 22; all west of the third meridian; subdivision of townships 1, 2, 3, 4 and 5, range 1, west of the fourth meridian. |
| Wallace, J. N. | Calgary, Alta.    | Survey of the Yukon-British Columbia boundary from Tatshenshini river to Takhini river  |
| Warren, Jas.   | Walkerton, Ont.   | Resurvey of the fourth base across ranges 2, 3 and 4; partial subdivision of township 13, range 2, townships 11, 12 and 13, range 3, townships 10 and 11, range 4, and townships 22 and 23, range 5; traverse in township 14, range 1; all west of the fifth meridian.  |
| Watt, Geo.     | Ottawa, Ont.      | Contract No. 9 of 1905; subdivision of townships 1, 2, 3, 8 and 9, range 13, township 8, ranges 14 and 15, townships 4, 5 and 7, ranges 16 and 17, townships 4, 5, 6 and 7, ranges 18 and 19; partial subdivision of townships 7, ranges 13, 14 and 15; survey of the east outlines of township 4, range 13, and townships 6, ranges 16 and 17; all west of the third meridian.                         |
| Wheeler, A. O. | Calgary, Alta.    | Examination and classification of the lands undisposed of in the railway belt, British Columbia, above and below Revelstoke, above and below Golden and in the vicinity of Shuswap lake.  |
| Wiggins, T. H. | Saskatoon, Sask.  | Correction survey in township 34, range 9, west of the third meridian.  |
| Young, W. H.   | Lethbridge, Alta. | Partial subdivision of township 4, range 1, township 6, range 2, townships 5, 6 and 7, range 3, and township 7, range 4; all west of the fifth meridian; partial subdivision of township 3, range 30, and traverse in townships 11, ranges 22 and 23; all west of the fourth meridian.  |

9-10 EDWARD VII., A. 1910

## APPENDIX No. 2.

SCHEDULE showing for each surveyor employed from April 1, 1908, to March 31, 1909, the number of miles surveyed of township section lines, township outlines, traverses of lakes and rivers and resurvey, also cost of same.

| Surveyor.           | Miles of section lines. | Miles of outlines. | Miles of traverse. | Miles of resurvey. | Total mileage. | Total cost. | Cost per mile. | By day work or by contract. |
|---------------------|-------------------------|--------------------|--------------------|--------------------|----------------|-------------|----------------|-----------------------------|
| Aylsworth, C. F.    |                         |                    | 5 30               | 270 50             | 275 80         | 9,855 00    | 35 73          | Day.                        |
| Baker, J. C.        | 421 38                  | 62 32              | 82 23              |                    | 565 93         | 16,024 84   | 28 31          | Contract.                   |
| Beatty, David       |                         |                    | 52 50              |                    | 52 50          | 6,733 00    | 128 24         | Day.                        |
| +Belanger, P. R. A. |                         |                    | 87 11              | 5 50               | 92 61          | 13,386 35   |                | "                           |
| Bingham, E. R.      |                         |                    | 5 31               |                    | 5 31           | 282 90      | 53 28          | "                           |
| Bolton, Lewis.      | 514 65                  |                    | 44 08              |                    | 558 73         | 4,286 63    | 7 67           | Contract.                   |
| Bongault, C. E.     |                         |                    | 26 05              | 334 75             | 360 80         | 9,063 96    | 25 12          | Day.                        |
| Bourgeault, A.      | 94 34                   | 10 08              | 10 50              |                    | 114 92         | 3,363 16    | 29 26          | Contract.                   |
| Bray, Edgar.        | 196 00                  | 30 00              | 5 50               |                    | 141 50         | 4,381 27    | 30 96          | "                           |
| Cantley, R. H.      | 1,148 60                | 50 20              | 42 33              |                    | 1,241 13       | 9,141 66    | 7 60           | "                           |
| Cantley, R. W.      | 359 88                  | 31 28              | 368 58             |                    | 759 74         | 12,773 40   | 16 81          | "                           |
| Christie, Wm.       | 10 00                   | 52 00              |                    | 64 50              | 126 50         | 7,310 57    | 57 79          | Day.                        |
| Côté, J. L.         | 532 92                  | 73 46              | 149 83             |                    | 747 21         | 19,980 71   | 26 74          | Contract.                   |
| Davies, T. A.       | 62 00                   |                    |                    | 58 50              | 120 50         | 10,273 17   | 85 25          | Day.                        |
| Deans, W. J.        | 33 00                   |                    | 16 80              | 127 50             | 177 30         | 8,000 00    | 45 12          | "                           |
| *Driscoll, A.       | 880 79                  | 90 84              | 117 52             |                    | 1,089 15       | 8,880 35    | 8 15           | Contract.                   |
| Dumais, P. T. C.    | 162 90                  | 17 00              | 60 02              |                    | 239 92         | 5,861 82    | 24 43          | "                           |
| Edwards, Geo.       | 133 10                  | 18 09              | 30 01              |                    | 181 20         | 5,058 37    | 27 91          | "                           |
| Fairchild, C. C.    | 348 63                  | 113 56             | 131 14             |                    | 593 33         | 16,959 50   | 28 58          | "                           |
| Farncomb, A. E.     | 340 12                  | 42 19              | 77 81              |                    | 460 12         | 12,361 24   | 26 86          | "                           |
| Fawcett, Adam.      | 316 21                  | 42 20              | 51 46              |                    | 409 87         | 10,957 21   | 26 73          | "                           |
| Fawcett, Thos.      |                         |                    | 14 55              | 171 75             | 186 30         | 4,466 78    | 23 98          | Day.                        |
| +Fontaine, L. E.    |                         |                    | 7 00               | 12 00              | 19 00          | 12,679 62   |                | "                           |
| Green, T. D.        | 1 00                    | 24 00              | 4 32               |                    | 29 32          | 4,200 00    | 143 24         | "                           |
| Hawkins, A. H.      | 8 00                    | 65 50              |                    |                    | 73 50          | 13,500 00   | 183 67         | "                           |
| Heathcott, R. V.    | 516 59                  | 56 34              | 180 66             |                    | 753 59         | 19,485 37   | 25 85          | Contract.                   |
| Holeroft, H. S.     | 163 75                  | 24 00              | 72 16              | 27 25              | 287 16         | 14,638 63   | 51 15          | Day.                        |
| Hopkins, M. W.      | 779 23                  | 70 29              | 259 05             |                    | 1,108 57       | 27,364 48   | 24 68          | Contract.                   |
| +Hubbell, E. W.     |                         |                    | 3 95               |                    | 3 95           | 12,628 23   |                | Day.                        |
| Johnson, A. W.      | 20 00                   |                    | 70 00              | 90 00              | 180 00         | 14,733 43   | 81 85          | "                           |
| Kimpe, M.           | 451 21                  | 32 68              | 27 33              |                    | 511 22         | 15,334 43   | 29 99          | Contract.                   |
| Kirk, J. A.         | 4 04                    |                    | 3 61               | 7 00               | 14 65          | 344 10      | 23 48          | Day.                        |
| Kitto, F. H.        | 86 72                   |                    | 29 11              |                    | 115 83         | 2,989 01    | 25 80          | Contract.                   |
| Knight, R. H.       | 336 15                  | 35 96              | 42 71              |                    | 414 82         | 11,842 63   | 28 55          | "                           |
| +Loneragan, G. J.   |                         |                    | 34 49              | 206 75             | 241 15         | 12,319 35   |                | Day.                        |
| McFarlane, W. G.    | 1,290 81                | 88 13              |                    |                    | 1,348 94       | 10,137 27   | 7 51           | Contract.                   |
| McFee, A.           |                         |                    | 69 50              |                    | 69 50          | 1,300 00    | 18 70          | Day.                        |
| McGrandle, Hugh     | 248 45                  |                    | 21 30              |                    | 269 75         | 7,045 59    | 26 12          | Contract.                   |
| McMillan, Geo.      |                         |                    | 96 75              | 221 00             | 317 75         | 10,714 79   | 33 72          | Day.                        |
| +Miles, C. F.       |                         |                    | 8 00               | 265 00             | 273 00         | 11,492 51   |                | "                           |
| Molloy, John        | 476 80                  | 42 66              |                    |                    | 519 46         | 15,418 30   | 29 68          | Contract.                   |
| Montgomery, R. H.   |                         |                    | 19 25              | 8 25               | 27 50          | 828 20      | 30 11          | Day.                        |
| Montgomery, R. H.   | 379 18                  | 18 09              | 33 70              |                    | 430 97         | 12,706 92   | 29 48          | Contract.                   |
| Morrier, J. E.      |                         |                    | 66 12              |                    | 66 12          | 5,339 04    | 80 74          | Day.                        |
| Ord, L. R.          | 228 62                  | 30 08              | 64 44              |                    | 323 14         | 7,512 99    | 23 25          | Contract.                   |
| Plunkett, Thos. H.  | 33 96                   |                    | 34 77              | 5 00               | 73 73          | 9,270 11    | 125 73         | Day.                        |
| Ponton, A. W.       |                         | 138 00             |                    |                    | 138 00         | 10,925 00   | 79 17          | "                           |
| Reilly, Wm. R.      |                         |                    | 154 34             | 242 50             | 396 84         | 8,817 98    | 22 22          | "                           |
| Robinson, E. W.     | 22 01                   |                    | 47 98              | 1 94               | 71 93          | 12,000 00   | 166 83         | "                           |
| Ross, Jos. E.       | 116 32                  |                    | 68 09              | 31 20              | 215 61         | 11,274 80   | 52 29          | "                           |
| Roy, Geo. P.        | 139 12                  |                    | 1 50               |                    | 140 62         | 4,262 33    | 30 31          | Contract.                   |
| Saint-Cyr, A.       |                         | 47 50              |                    |                    | 47 50          | 15,000 00   | 315 79         | Day.                        |
| Saint-Cyr, J. B.    | 115 00                  | 20 00              | 53 60              |                    | 190 60         | 10,450 00   | 54 82          | "                           |
| Saunders, B. J.     |                         | 67 50              |                    |                    | 67 50          | 15,100 00   | 223 70         | "                           |
| Selby, H. W.        | 255 25                  | 52 90              | 67 72              |                    | 375 87         | 12,505 09   | 33 27          | "                           |
| Seymour, H. L.      | 514 48                  | 66 94              | 32 16              |                    | 613 58         | 16,510 01   | 26 90          | Contract.                   |
| *Stacey, A. G.      | 181 42                  | 12 06              |                    |                    | 193 48         | 1,574 59    | 8 13           | "                           |
| Steele, L. J.       | 1,287 55                | 126 03             | 114 14             |                    | 1,527 72       | 10,809 58   | 7 07           | "                           |
| Talbot, A. C.       | 2 00                    |                    | 8 00               |                    | 10 00          | 667 75      | 66 77          | Day.                        |
| Teasdale, C. M.     | 462 74                  | 30 07              | 75 85              |                    | 568 66         | 14,978 77   | 26 34          | Contract.                   |
| Tyrrell, J. W.      | 511 22                  | 23 59              | 5 77               |                    | 540 58         | 15,996 50   | 29 59          | "                           |
| Waddell, W. H.      | 375 29                  |                    | 106 73             |                    | 481 95         | 12,304 99   | 25 53          | "                           |
| Waldron, John.      | 1,260 51                | 118 59             | 2 93               |                    | 1,382 03       | 10,931 49   | 7 91           | "                           |
| Wallace, J. N.      |                         |                    | 36 80              |                    | 36 80          | 15,530 09   | 422 01         | Day.                        |
| Warren, Jas.        | 77 50                   | 8 00               | 18 00              | 19 00              | 122 50         | 9,308 77    | 75 99          | "                           |
| Watt, Geo. H.       | 1,125 15                | 173 50             | 5 75               |                    | 1,304 40       | 10,829 20   | 8 30           | Contract.                   |
| Wiggins, T. H.      |                         |                    |                    | 3 50               | 3 50           | 65 00       | 18 57          | Day.                        |
| Young, W. H.        | 79 90                   | 13 00              | 4 49               | 2 00               | 99 39          | 9,000 00    | 90 55          | "                           |
|                     | 16,984 42               | 2,018 63           | 3,323 61           | 2,175 39           | 24,502 05      | 681,418 74  |                |                             |

\* Mr. A. G. Stacey, D.L.S., died and the contract was completed by A. Driscoll, D.L.S., with the same party. † Inspector of contract surveys.

SESSIONAL PAPER No. 25

APPENDIX No. 3.

List of Lots in the Yukon Territory, surveys of which have been received from April 1, 1908, to March 31, 1909.

GROUP No. 1.

| Lot No. | Area in Acres. | Surveyor.        | Year of Survey. | Date of Approval. | Claimant.        | Remarks. |
|---------|----------------|------------------|-----------------|-------------------|------------------|----------|
| 41      | 68.1           | C. S. W. Barwell | 1908            | *                 | Albert P. Shulze | Surface. |

GROUP No. 2.

|      |       |                  |      |                |   |                                 |
|------|-------|------------------|------|----------------|---|---------------------------------|
| N 1  | 0.363 | James Gibbon     | 1907 | June 10, 1908  |   | Surface.                        |
| K 24 |       | C. W. MacPherson | 1908 | *              | White Channel Gold Hill Hydraulic Co., Ltd. | "                               |
| 180  | 46.2  | C. S. W. Barwell | 1908 | *              | Capt. T. H. Alcock                          | Riverview M. C.                 |
| 375  | 51.6  | "                | 1908 | Feb 23, 1908   | Ernest Sleuter                              | New Hope M. C.                  |
| 376  | 51.6  | "                | 1908 | Nov. 11, 1908  | Lizzie Olivia Craig                         | Iron Duke M. C.                 |
| 377  | 51.6  | "                | 1908 | " 11, 1908     | "   | Black Prince M. C.              |
| 378  | 51.6  | "                | 1908 | " 11, 1908     | "   | Belle M. C.                     |
| 378  |       | "                | 1908 | *              | N. A. T. & T. Co.                           | Klondike Lode M. C.             |
| 380  | 51.3  | "                | 1908 | Nov. 11, 1908  | Lizzie Olivia Craig                         | Chas. L. M. C.                  |
| 387  | 640.0 | C. W. MacPherson | 1907 | *              | Dept. of Indian Affairs.                    | Indian Reserve.                 |
| 389  | 20.85 | James Gibbon     | 1908 | Sept. 11, 1908 | John Nicholas                               | Tacoma M. C.                    |
| 392  | 51.3  | C. S. W. Barwell | 1908 | Nov. 11, 1908  | Lizzie Olivia Craig                         | Walter D. M. C.                 |
| 393  | 51.6  | "                | 1908 | " 11, 1908     | "   | Thelma M. C.                    |
| 394  | 51.6  | "                | 1908 | " 11, 1908     | "   | Lottie M. C.                    |
| 395  | 45.9  | "                | 1908 | *              | N. A. T. & T. Co.                           | Klondike Lode Ext'n No. 1 M. C. |
| 396  | 32.73 | James Gibbon     | 1908 | Sept. 11, 1908 | Margaret J. Mitchell <i>et al.</i>          | Comstock M. C.                  |
| 398  | 51.65 | "                | 1908 | " 11, 1908     | Jane S. Orrell                              | Silver Knight M. C.             |
| 400  | 47.5  | C. S. W. Barwell | 1908 | Oct. 2, 1908   | Emil Mohr                                   | Edna M. C.                      |
| 401  | 11.5  | "                | 1908 | *              | N. A. T. & T. Co.                           | Surface.                        |
| 402  | 11.5  | "                | 1908 | *              | "   | "                               |
| 403  | 51.0  | "                | 1908 | *              | "   | Klondike Lode Ext'n No. 3 M. C. |
| 404  | 50.5  | "                | 1908 | *              | L. Schmidt                                  | An Curd M. C.                   |
| 405  | 51.6  | "                | 1909 | *              | Thos. Mulcahey <i>et al.</i>                | Dunsmuir M. C.                  |
| 406  | 51.6  | "                | 1909 | *              | "   | Bald Eagle M. C.                |
| 407  | 51.6  | "                | 1909 | *              | "   | Black Jack M. C.                |

GROUP No. 4.

|     |       |                  |      |              |                             |          |
|-----|-------|------------------|------|--------------|-----------------------------|----------|
| B 3 | 11.24 | C. W. MacPherson | 1908 | Oct. 3, 1908 | The English Church Missions | Surface. |
|-----|-------|------------------|------|--------------|-----------------------------|----------|

\*Not yet approved.

9-10 EDWARD VII., A. 1910

## GROUP No. 5.

| Lot No. | Area in Acres. | Surveyor.     | Year of Survey. | Date of Approval. | Claimant.                  | Remarks.                        |
|---------|----------------|---------------|-----------------|-------------------|----------------------------|---------------------------------|
| 110     | 51.55          | H. G. Dickson | 1907            | *                 | A. B. Palmer               | Centre Star M. C.               |
| 111     | 46.37          | "             | 1907            | *                 | "                          | Papoose M. C.                   |
| 112     | 49.14          | "             | 1907            | *                 | "                          | Morning M. C.                   |
| 113     | 30.35          | "             | 1907            | *                 | "                          | Mack M. C.                      |
| 115     | 45.56          | "             | 1908            | *                 | Wm. Clark                  | Verona M. C.                    |
| 121     | 0.77           | N. A. Burwash | 1908            | Sept. 25, 1908.   | F. R. Alley                | Flora M. C.                     |
| 122     | 13.15          | "             | 1908            | " 25, 1908.       | "                          | Alma M. C.                      |
| 123     | 9.88           | "             | 1908            | " 25, 1908.       | "                          | Midget M. C.                    |
| 124     | 2.09           | "             | 1908            | " 25, 1908.       | "                          | Flora No. 2 M. C.               |
| 125     | 49.07          | "             | 1908            | " 25, 1908.       | W. S. Thomas               | Copper Chief M. C.              |
| 126     | 39.58          | "             | 1908            | " 25, 1908.       | "                          | Copper Nugget M. C.             |
| 127     | 138.67         | "             | 1908            | Oct. 17, 1908.    | L. E. Belney and Karl Weik | Manitou Copper M. C.            |
| 128     | 49.48          | "             | 1908            | " 17, 1908.       | W. S. Thomas               | Kluane M. C.                    |
| 129     | 48.91          | "             | 1908            | " 17, 1908.       | "                          | Little Johnnie M. C.            |
| 130     | 31.62          | "             | 1908            | " 17, 1908.       | "                          | Overland M. C.                  |
| 131     | 3.98           | "             | 1908            | Sept. 25, 1908.   | "                          | Corsair M. C.                   |
| 132     | 47.58          | "             | 1908            | Oct. 17, 1908.    | L. E. Belney and Karl Weik | Grover M. C.                    |
| 133     | 51.65          | "             | 1908            | July 15, 1908.    | W. S. Thomas               | Paragon M. C.                   |
| 134     | 48.17          | "             | 1908            | Sept. 25, 1908.   | "                          | Ora M. C.                       |
| 135     | 47.08          | "             | 1908            | " 25, 1908.       | "                          | Alvia M. C.                     |
| 136     | 44.74          | "             | 1908            | July 15, 1908.    | "                          | Little Frank M. C.              |
| 137     | 51.65          | "             | 1908            | " 15, 1908.       | "                          | I. O. U. M. C.                  |
| 138     | 51.65          | "             | 1908            | " 15, 1908.       | "                          | I. and E. M. C.                 |
| 139     | 51.38          | "             | 1908            | " 15, 1908.       | "                          | Reta M. C.                      |
| 140     | 51.63          | "             | 1908            | " 15, 1908.       | "                          | Bernice M. C.                   |
| 141     | 51.49          | "             | 1908            | " 15, 1908.       | "                          | York M. C.                      |
| 143     | 45.94          | "             | 1908            | " 8, 1908.        | "                          | Helena M. C.                    |
| 144     | 17.58          | "             | 1908            | " 8, 1908.        | "                          | Florence M. C.                  |
| 145     | 31.02          | "             | 1908            | " 8, 1908.        | "                          | Iron Horse M. C.                |
| 146     | 13.74          | "             | 1908            | " 8, 1908.        | S. C. Barrington           | Carnage M. C.                   |
| 148     | 47.03          | "             | 1908            | " 8, 1908.        | W. S. Thomas               | Rotisay, M. C.                  |
| 149     | 39.24          | "             | 1908            | Sept. 28, 1908.   | "                          | Autumn M. C.                    |
| 150     | 12.02          | "             | 1908            | July 7, 1908.     | "                          | Sour Dough M. C.                |
| 154     | 28.48          | H. G. Dickson | 1908            | June 29, 1908.    | E. A. Dickson              | Dick M. C.                      |
| 155     | 45.77          | "             | 1908            | " 29, 1908.       | Paul Jameson               | Hope M. C.                      |
| 156     | 51.65          | "             | 1908            | *                 | William Maher              | Copper Cliff M. C.              |
| 157     | 11.35          | "             | 1908            | March 2, 1909     | C. H. Johnston             | Mabel Extension<br>Frae'n M. C. |
| 176     | 33.65          | N. A. Burwash | 1908            | July 15, 1908.    | W. S. Thomas               | Pueblo Star No. 2<br>M. C.      |
| 177     | 1.37           | "             | 1908            | Sept. 25, 1908.   | W. L. Forrest              | Flora No. 3 (Fractional) M. C.  |
| 178     | 16.46          | "             | 1908            | " 25, 1908.       | K. Weik                    | Dawson M. C.                    |
| 179     | 14.00          | "             | 1908            | Feb. 2, 1909.     | P. F. Scharschmidt         | Surface.                        |
| 180     | 21.91          | "             | 1908            | Oct. 2, 1908.     | A. B. Palmer               | Pruence M. C.                   |
| 181     | 6.36           | "             | 1908            | " 2, 1908.        | "                          | Pocahauntus M. C.               |

\*Not yet approved.

SESSIONAL PAPER No. 25

GROUP No. 6.

| Lot No. | Area in Acres. | Surveyor.       | Year of Survey. | Date of Approval. | Claimant.                    | Remarks.                   |
|---------|----------------|-----------------|-----------------|-------------------|------------------------------|----------------------------|
| 20      | 50.41          | H. G. Dickson.. | 1907            | *                 | J. H. Conrad                 | Venus M. C.                |
| 21      | 51.13          | "               | 1907            | *                 | "                            | Venus No. 2 M. C.          |
| 22      | 11.12          | "               | 1907            | *                 | "                            | Venus Fraction M.C.        |
| 24      | 3.52           | "               | 1907            | *                 | "                            | Mars M. C.                 |
| 25      | 51.08          | "               | 1907            | *                 | "                            | M. & M. M. C.              |
| 26      | 21.48          | "               | 1907            | *                 | "                            | Vault M. C.                |
| 27      | 51.65          | "               | 1907            | *                 | "                            | Uranus M. C.               |
| 28      | 50.83          | "               | 1907            | *                 | "                            | Uranus No. 2 M. C.         |
| 29      | 23.02          | "               | 1907            | *                 | "                            | Cappella M. C.             |
| 30      | 44.31          | "               | 1907            | *                 | "                            | Joe Petty M. C.            |
| 31      | 46.75          | "               | 1907            | *                 | "                            | Little Johnny M. C.        |
| 32      | 32.58          | "               | 1907            | June 24, 1908.    | "                            | Reliance M. C.             |
| 33      | 51.65          | "               | 1907            | *                 | "                            | Black Jack M. C.           |
| 34      | 51.65          | "               | 1908            | Jan. 19, 1909.    | "                            | Montana M. C.              |
| 35      | 50.94          | "               | 1908            | " 19, 1909.       | "                            | Mountain Hero M.C.         |
| 36      | 51.16          | "               | 1907            | *                 | "                            | Monarch M. C.              |
| 37      | 42.10          | "               | 1908            | Jan. 19, 1909.    | "                            | Commander M. C.            |
| 38      | 31.09          | "               | 1908            | " 19, 1909.       | "                            | Jumbo M. C.                |
| 39      | 35.03          | "               | 1908            | " 19, 1909.       | "                            | O. K. M. C.                |
| 40      | 37.33          | "               | 1908            | *                 | W. P. Granger.               | Lake Shore M. C.           |
| 41      | 10.15          | "               | 1908            | Jan. 19, 1909.    | J. H. Conrad.                | Fox M. C.                  |
| 42      | 17.45          | "               | 1908            | " 19, 1909.       | "                            | Mountain Lion M.C.         |
| 43      | 35.97          | "               | 1908            | " 19, 1909.       | "                            | Elephant M. C.             |
| 44      | 51.65          | "               | 1907            | Apr. 24, 1908.    | "                            | 4th of July M. C.          |
| 45      | 50.11          | "               | 1907            | " 19, 1908.       | "                            | Gurteen M. C.              |
| 46      | 43.86          | "               | 1907            | *                 | "                            | Empress M. C.              |
| 47      | 40.01          | "               | 1907            | *                 | "                            | Princess No. 2 M. C.       |
| 48      | 45.84          | "               | 1907            | *                 | "                            | T. & B. M. C.              |
| 49      | 40.80          | "               | 1907            | *                 | "                            | Sunrise M. C.              |
| 50      | 39.62          | "               | 1907            | *                 | "                            | Sunset M. C.               |
| 51      | 35.75          | "               | 1907            | *                 | "                            | Thistle M. C.              |
| 52      | 44.01          | "               | 1907            | *                 | "                            | Rose M. C.                 |
| 53      | 6.61           | "               | 1907            | *                 | "                            | Fair Play M. C.            |
| 55      | 40.21          | "               | 1907            | *                 | "                            | Aurora M. C.               |
| 56      | 51.65          | "               | 1907            | *                 | "                            | Glacial Lake M. C.         |
| 57      | 19.15          | "               | 1907            | *                 | "                            | Columbian M. C.            |
| 58      | 24.21          | "               | 1907            | *                 | "                            | Westover M. C.             |
| 59      | 8.98           | "               | 1908            | Jan. 19, 1909.    | "                            | Mamouth M. C.              |
| 61      | 51.65          | "               | 1907            | *                 | "                            | Caribou M. C.              |
| 62      | 51.55          | "               | 1907            | *                 | "                            | Pride of Yukon M.C.        |
| 63      | 47.48          | "               | 1907            | *                 | "                            | Pride of Yukon No. 2 M. C. |
| 64      | 40.16          | "               | 1907            | *                 | "                            | Jupiter M. C.              |
| 65      | 51.64          | "               | 1907            | *                 | "                            | Lone Jack M. C.            |
| 66      | 44.79          | "               | 1907            | *                 | "                            | Chesley M. C.              |
| 67      | 47.67          | "               | 1907            | *                 | "                            | Eureka M. C.               |
| 68      | 47.42          | "               | 1907            | *                 | "                            | Eureka No. 2 M. C.         |
| 69      | 9.04           | "               | 1907            | *                 | "                            | Nipper M. C.               |
| 70      | 49.65          | "               | 1907            | *                 | "                            | Royston M. C.              |
| 71      | 42.90          | "               | 1907            | *                 | "                            | Pedro M. C.                |
| 72      | 24.80          | "               | 1907            | *                 | "                            | Vega M. C.                 |
| 73      | 29.29          | "               | 1907            | *                 | "                            | Vanguard M. C.             |
| 74      | 29.14          | "               | 1907            | *                 | "                            | Dawson M. C.               |
| 75      | 49.86          | "               | 1907            | *                 | "                            | Bellajara M. C.            |
| 76      | 34.69          | "               | 1907            | *                 | "                            | Amex M. C.                 |
| 77      | 79.91          | "               | 1907            | Mar. 2, 1909.     | "                            | Surface.                   |
| 78      | 14.00          | "               | 1908            | *                 | J. M. Pooley & J. M. Stewart | Maybelle (Fraction M. C.   |
| 98      | 48.89          | "               | 1907            | *                 | Jas. C. Grace                | Washington M. C.           |
| 99      | 51.65          | "               | 1908            | *                 | Laura Hill.                  | Legal Tender M. C.         |
| 100     | 50.40          | "               | 1908            | *                 | E. M. Morgan.                | Azurite M. C.              |
| 101     | 47.74          | "               | 1908            | *                 | "                            | Malachite M. C.            |
| 102     | 49.83          | "               | 1908            | *                 | "                            | Cromwell M. C.             |

\*Not yet approved.

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## APPENDIX No. 4.

LIST of Miscellaneous Surveys in the Yukon Territory, returns of which have been received from April 1, 1908, to March 31, 1909.

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| Year. | Surveyor.       | Description of Survey.  |
|-------|-----------------|---|
| 1901  | P. T. C. Dumais | Glacier creek base line (part of) a tributary of Gold creek.    |
| 1901  | "               | Moose creek base line (part of) a tributary of Fortymile river. |

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SESSIONAL PAPER No. 25

## APPENDIX No. 5.

## STATEMENT of work executed in the office of the chief draughtsman:—

|   |       |
|---|-------|
| Letters of instruction to surveyors. . . . .  | 225   |
| Progress sketches received and filed . . . . .  | 1,308 |
| Declarations of settlers received and filed. . . . .  | 436   |
| Returns of separate blocks of timber berths received. . . . .   | 300   |
| Plans received from surveyors. . . . .  | 503   |
| Field books received from surveyors. . . . .  | 750   |
| Timber reports received. . . . .  | 276   |
| Observations for magnetic declination received. . . . .   | 11    |
| Preliminary township plans prepared. . . . .  | 492   |
| Sketches made. . . . .  | 2,163 |
| Maps and tracings made. . . . .   | 342   |
| Plans of Yukon lots received. . . . .   | 154   |
| Plans of miscellaneous Yukon surveys received. . . . .  | 6     |
| Tracings of Yukon survey plans made. . . . .  | 163   |
| Yukon lots reduced to 40 chains to 1 inch and plotted on<br>group plans. . . . .  | 242   |
| Yukon traverses reduced to 40 chains to 1 inch and plotted on<br>group plans. . . . .                                   | 8     |
| Returns of surveys examined—  |       |
| Township subdivision. . . . .   | 501   |
| Township outline. . . . .   | 370   |
| Road plans. . . . .   | 280   |
| Railway plans. . . . .  | 76    |
| Mineral claims. . . . .   | 17    |
| Timber berths. . . . .  | 213   |
| Correction and other miscellaneous surveys. . . . .   | 105   |
| Township plans compiled. . . . .  | 692   |
| Townsite settlement and other plans compiled. . . . .   | 14    |
| Proofs of plans examined. . . . .   | 487   |
| Township plans printed. . . . .   | 609   |
| Townsite and settlement plans printed. . . . .  | 14    |
| Descriptions written. . . . .   | 9     |
| Pages of field notes copied. . . . .  | 463   |
| Applications for various information dealt with. . . . .  | 2,034 |
| Files received and returned. . . . .  | 2,124 |
| Letters drafted. . . . .  | 6,476 |
| Books received from record office and used in connection<br>with office work. . . . .                                   | 5,237 |
| Books returned to record office. . . . .  | 6,136 |
| Plans other than printed township plans received from<br>record office and used in connection with office work. . . . . | 1,038 |
| Plans returned to record office. . . . .  | 1,061 |
| Volumes of plans received from record office and used in<br>connection with office work. . . . .                        | 93    |
| Volumes of plans returned to record office. . . . .   | 105   |
| Books sent to record office to be placed on record. . . . .   | 615   |
| Plans other than township plans sent to record office to be<br>placed on record. . . . .                                | 429   |

9-10 EDWARD VII., A. 1910

APPENDIX No. 5—*Continued.*

|  |    |
|--|----|
| Sectional maps (3 miles to 1 inch)—          |    |
| Revised. . . . .                             | 46 |
| Reprinted. . . . .                           | 34 |
| New drawings of old worn out sheets. . . . . | 1  |
| New tracings of old worn out sheets. . . . . | 8  |
| Sectional maps (6 miles to 1 inch)—          |    |
| Reprinted. . . . .                           | 11 |
| Proofs of sectional sheets examined. . . . . | 47 |



SESSIONAL PAPER No. 25

## APPENDIX No. 6.

LIST of new editions of sectional maps issued from April 1, 1908, to March 31, 1908.

[Scale 3 miles to 1 inch.]

| No. | Name.                | No. | Name.                 | No. | Name.               | No. | Name.            |
|-----|----------------------|-----|-----------------------|-----|---------------------|-----|------------------|
| 18  | Wood Mountain.....   | 72  | Portage la Prairie .. | 166 | Sounding Creek .... | 268 | Carlton.         |
| 19  | Willowbunch. ....    | 114 | Calgary .....         | 167 | Bad Hills. ....     | 269 | Prince Albert    |
| 20  | Souris .....         | 115 | Blackfoot .....       | 169 | Touchwood .....     | 270 | Pasquia.         |
| 21  | Turtle Mountain..... | 116 | Rainy Hills. ....     | 170 | Yorkton .....       | 271 | Mossy Portage.   |
| 23  | Emerson.....         | 117 | Red Deer Forks ..     | 214 | Rocky Mt. House ..  | 317 | Fort Pitt.       |
| 24  | Lake of the Woods .. | 118 | Rush Lake .....       | 217 | Tramping Lake ....  | 318 | Shell River.     |
| 64  | Porcupine .....      | 119 | Regina .....          | 218 | Saskatoon .....     | 319 | Prince Albert N. |
| 69  | Moosejaw .....       | 121 | Riding Mountain....   | 219 | Humboldt .....      |     |                  |
| 70  | Moose Mountain.....  | 123 | Fort Alexander.....   | 221 | Swan River .....    |     |                  |

[Scale 6 miles to 1 inch.]

|     |                 |     |                    |     |                     |     |              |
|-----|-----------------|-----|--------------------|-----|---------------------|-----|--------------|
| 22  | Dufferin.....   | 215 | Red Deer .....     | 265 | Peace Hills.....    | 366 | Saddle Lake. |
| 164 | Mo'ley .....    | 216 | Sullivan Lake..... | 266 | Ribstone Creek .... | 416 | La Biche.    |
| 168 | The Elbow ..... | 264 | Brazeau.....       | 267 | Battleford .....    |     |              |

9-10 EDWARD VII., A. 1910

## APPENDIX No. 7.

STATEMENT of work executed in the survey records office from April 1, 1908, to  
March 31, 1909.

|   |         |
|---|---------|
| Files received and dealt with. . . . .              | 15,078  |
| Letters drafted. . . . .                            | 4,741   |
| Reports, memos, to Council, drafts. . . . .         | 1       |
| Plans, tracings, &c., copied or compiled. . . . .   | 742     |
| Statutory declarations copied or mailed. . . . .    | 407     |
| Plans sent to agents, registrars, &c. . . . .       | 19,578  |
| Pages of field notes copied. . . . .                | 892     |
| Prints of plans received and stored. . . . .        | 179,725 |
| Original plans received and recorded. . . . .       | 1,238   |
| Original field notes received and recorded. . . . . | 596     |
| Letters written to agents. . . . .                  | 1,444   |
| Registered parcels mailed. . . . .                  | 1,739   |

*Work performed for the Topographical Surveys Branch.*

|                               |       |
|-------------------------------|-------|
| Books searched for. . . . .   | 7,552 |
| Books sent. . . . .           | 5,973 |
| Books returned. . . . .       | 6,775 |
| Plans searched for. . . . .   | 3,386 |
| Plans sent. . . . .           | 2,515 |
| Plans returned. . . . .       | 1,229 |
| Volumes searched for. . . . . | 99    |
| Volumes sent. . . . .         | 69    |
| Volumes returned. . . . .     | 132   |

*Work done for the Patents Branch.*

|                                   |       |
|-----------------------------------|-------|
| Plans searched for. . . . .       | 1,070 |
| Plans sent. . . . .               | 1,034 |
| Plans returned. . . . .           | 916   |
| Field books searched for. . . . . | 83    |
| Field books sent. . . . .         | 82    |
| Field books returned. . . . .     | 37    |

*Work done for other Branches.*

|                                   |     |
|-----------------------------------|-----|
| Plans searched for. . . . .       | 533 |
| Plans sent. . . . .               | 529 |
| Plans returned. . . . .           | 464 |
| Field books searched for. . . . . | 360 |
| Field books sent. . . . .         | 352 |
| Field books returned. . . . .     | 424 |

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## APPENDIX No. 8.

STATEMENT of work executed in the photographic office from April 1, 1908, to March 31, 1909.

|                             | 3¼ x 3¼ | 4 x 5 | 5 x 7 | 8 x 10 | 10 x 12 | 11 x 14 | 16 x 18 | 18 x 20 | 24 x 30 | 30 x 36 | 36 x 42 | 42 x 48 | Total. |
|-----------------------------|---------|-------|-------|--------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| Dry plate negatives.....    |         | 316   | 848   |        |         | 48      |         |         |         |         |         |         | 1,212  |
| Bromide prints.....         |         | 36    | 44    | 311    | 82      | 139     | 179     | 141     | 50      | 24      | 8       | 3       | 1,017  |
| Vandyke prints.....         |         |       |       | 5      | 17      | 48      | 108     | 89      | 86      | 61      | 32      | 13      | 459    |
| Silver prints.....          |         | 1,822 | 4,293 | 52     |         | 21      | 9       |         |         |         |         |         | 5,697  |
| Lantern transparencies..... | 390     |       |       |        |         |         |         |         |         |         |         |         | 390    |
| Photographs mounted.....    |         |       | 468   | 46     | 1       | 67      | 93      | 10      |         |         |         |         | 685    |
| Wet plate negatives.....    |         |       |       | 127    |         | 134     | 770     | 230     |         |         |         |         | 1,261  |
| Photo litho plates.....     |         |       |       |        |         |         |         | 872     |         |         |         |         | 872    |
|                             | 390     | 1,674 | 5,653 | 541    | 100     | 457     | 1,159   | 1,342   | 136     | 85      | 40      | 16      | 11,503 |

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## APPENDIX No. 9.

STATEMENT of work executed in the lithographic office from April 1, 1908, to March 31, 1909.

| MONTH.         | MAPS. |         | TOWNSHIPS. |         | FORMS, &c. |         |
|----------------|-------|---------|------------|---------|------------|---------|
|                | No.   | Copies. | No.        | Copies. | No.        | Copies. |
| 1908.          |       |         |            |         |            |         |
| April.....     | 11    | 750     | 50         | 10,000  | 13         | 7,140   |
| May.....       | 1     | 200     | 38         | 7,600   | 22         | 7,370   |
| June.....      | 11    | 3,850   | 96         | 19,200  | 4          | 3,550   |
| July.....      | 10    | 55,200  |            |         | 3          | 3,200   |
| August.....    | 7     | 6,750   | 7          | 1,400   | 10         | 14,950  |
| September..... |       |         | 92         | 18,400  | 1          | 3,000   |
| October.....   | 3     | 2,700   | 25         | 5,000   | 6          | 10,175  |
| November.....  | 3     | 3,200   | 25         | 5,000   | 3          | 750     |
| December.....  | 10    | 4,600   | 73         | 14,600  | 5          | 8,350   |
| 1909.          |       |         |            |         |            |         |
| January.....   | 10    | 4,725   | 105        | 21,000  |            |         |
| February.....  | 10    | 11,850  | 33         | 6,600   | 1          | 2,000   |
| March.....     | 17    | 46,025  | 38         | 7,600   | 5          | 1,700   |
| Total.....     | 93    | 139,850 | 582        | 116,400 | 73         | 62,185  |

## RECAPITULATION.

|                | No. | Copies. | Impressions. | Cost.    |
|----------------|-----|---------|--------------|----------|
|                |     |         |              | \$ cts.  |
| Maps.....      | 93  | 139,850 | 305,317      | 2,659 28 |
| Townships..... | 582 | 116,400 | 118,400      | 4,493 04 |
| Forms, &c..... | 73  | 62,185  | 70,735       | 975 68   |
| Total.....     | 748 | 318,435 | 494,452      | 8,128 00 |

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## APPENDIX No. 10.

LIST of employees of the Topographical Surveys Branch at Ottawa, giving the name, classification, duties of office and salary of each.

(Metcalfe Street, Corner of Slater.)

| Name.                              | CLASSIFICATION. |               | Duties of Office.             | Salary. |      |
|------------------------------------|-----------------|---------------|-------------------------------|---------|------|
|                                    | Division        | Sub-division. |                               | \$      | cts. |
| Deville, E., D.T.S., LL.D. . . . . | 1               | A             | Surveyor General. . . . .     | 3,200   | 00   |
| CORRESPONDENCE.                    |                 |               |                               |         |      |
| Brady, M. . . . .                  | 1               | B             | Secretary. . . . .            | 2,100   | 00   |
| Cullen, M. J. . . . .              | 3               | A             | Stenographer. . . . .         | 1,000   | 00   |
| Moran, J. F. . . . .               | 3               | B             | Typewriter and clerk. . . . . | 550     | 00   |
| Williams, E. R. . . . .            | 3               | B             | Correspondence clerk. . . . . | 600     | 00   |
| Lynch, F. . . . .                  | 3               | B             | Typewriter. . . . .           | 700     | 00   |
| Addison, W. G. . . . .             | 3               | B             | Typewriter. . . . .           | 500     | 00   |
| Paquette, A. . . . .               | 3               | B             | Clerk. . . . .                | 700     | 00   |
| Pegg, A. . . . .                   |                 |               | Messenger. . . . .            | 700     | 00   |
| ACCOUNTS.                          |                 |               |                               |         |      |
| Hunter, R. H. . . . .              | 2               | A             | Accountant . . . . .          | 1,800   | 00   |
| Wilkinson, Percy . . . . .         | 3               | A             | Asst. accountant. . . . .     | 900     | 00   |

## DRAUGHTING OFFICE.

General direction and supervision of the technical work.

|                                     |   |   |                                  |       |    |
|-------------------------------------|---|---|----------------------------------|-------|----|
| Symes, P. B. . . . .                | 1 | B | Chief draughtsman. . . . .       | 2,100 | 00 |
| Shanks, T., B.A.Sc., D.L.S. . . . . | 1 | B | Asst. chief draughtsman. . . . . | 2,100 | 00 |

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DRAUGHTING OFFICE—FIRST DIVISION.

REGISTRATION of Surveyors' plans, field notes and other documents; preparation of instructions to surveyors, annual and other reports; answering inquiries about surveys and preparing preliminary plans of townships.

| Name.                                       | CLASSIFICATION. |               | Duties of Office.       | Salary.  |
|---|-----------------|---------------|-------------------------|----------|
|   | Division        | Sub-division. |                         |          |
|   |                 |               |                         | \$ cts.  |
| Brown, T. E., B.A.                          | 1               | B             | Chief of division       | 2,100 00 |
| Green, W. T., B.A., D.L.S.                  | 2               | A             | Asst. chief of division | 1,600 00 |
| Umbach, J. E., Grad. S.P.S., D.L.S.         | 2               | A             | " "                     | 1,600 00 |
| Berber, H. G., Grad. S.P.S., D.L.S.         | 2               | A             | " "                     | 1,600 00 |
| Rice, F. W., Grad. School of Mining, D.L.S. | 2               | A             | " "                     | 1,600 00 |
| Belleau, J. A., D.L.S.                      | 2               | A             | " "                     | 1,600 00 |
| McRae, A. D., B.A., B. Sc.                  | 2               | B             | Draughtsman             | 1,100 00 |
| Carroll, M. J., Grad. S.P.S.                | 2               | B             | "                       | 1,300 00 |
| Grant, A. W., B.A.                          | 2               | B             | "                       | 1,100 00 |
| Peaker, W. J., Grad. S.P.S.                 | 2               | B             | "                       | 1,000 00 |
| Grant, A. M., B. Sc.                        | 2               | B             | "                       | 1,000 00 |
| Milliken, J. B., B.A., B. Sc.               | 2               | B             | "                       | 1,000 00 |
| MacMillan, J. P., B.E.                      | 2               | B             | "                       | 1,000 00 |
| Cordukes, J. P., B. Sc.                     | 2               | B             | "                       | 900 00   |
| Wadlin, L. N., B. Sc.                       | 2               | B             | "                       | 900 00   |
| Hayward, H. E., B. Sc.                      | 2               | B             | "                       | 1,000 00 |
| Sylvain, J.                                 | 2               | B             | "                       | 1,450 00 |
| Rochon, E. C.                               | 2               | B             | "                       | 1,100 00 |
| McLanghin, M. J.                            | 2               | B             | "                       | 1,100 00 |
| Holbrook, C. H.                             | 3               | B             | Clerk                   | 700 00   |
| Burkholder, F. L.                           | 3               | B             | "                       | 550 00   |

DRAUGHTING OFFICE—SECOND DIVISION.

EXAMINING the returns of surveys in Manitoba, Saskatchewan and Alberta; plotting the plans of townships and checking the accounts for contract surveys.

|  |   |   |                         |          |
|--|---|---|-------------------------|----------|
| Nash, T. S., Grad. S.P.S., D.L.S.            | 1 | B | Chief of division       | 2,100 00 |
| Henderson, F. D., Grad. S.P.S., D.L.S.       | 2 | A | Asst. chief of division | 1,600 00 |
| Burgess, E. L., Grad. S.P.S., D.L.S., O.L.S. | 2 | A | " "                     | 1,600 00 |
| Dennis, E. M., B. Sc., D.L.S.                | 2 | A | " "                     | 1,600 00 |
| Elder, A. J., Grad. S.P.S., D.L.S.           | 2 | A | " "                     | 1,600 00 |
| Hill, S. N., Grad. S.P.S.                    | 2 | A | " "                     | 1,600 00 |
| Elwell, Wm., Grad. S.P.S.                    | 2 | A | " "                     | 1,600 00 |
| Cumming, A. L., B. Sc., D.L.S.               | 2 | A | " "                     | 1,600 00 |
| Sutherland, H. E., B. Sc.                    | 2 | B | Draughtsman             | 1,100 00 |
| Robertson, D. F., Grad. S.P.S.               | 2 | B | "                       | 1,300 00 |
| Chann, T. H. G., D.L.S.                      | 2 | B | "                       | 1,450 00 |
| Kitto, F. H., D.L.S.                         | 2 | B | "                       | 1,200 00 |
| Bonnell, M. B., B.A. Sc.                     | 2 | B | "                       | 1,000 00 |
| Norrish, B.E., B. Sc.                        | 2 | B | "                       | 900 00   |
| McCleannan, W. D.                            | 2 | B | "                       | 1,350 00 |
| Roger, A.                                    | 2 | B | "                       | 1,350 00 |
| Spreekley, R. O.                             | 2 | B | "                       | 1,200 00 |
| Goodday, Leonard.                            | 2 | B | "                       | 1,100 00 |
| Williamson, F. H. H.                         | 2 | B | "                       | 1,100 00 |
| Webb, G. C.                                  | 2 | B | "                       | 1,100 00 |
| Bray, R. P.                                  | 2 | B | "                       | 1,100 00 |
| Harrison, E. W.                              | 2 | B | "                       | 1,000 00 |
| Ault, H. W.                                  | 2 | B | "                       | 1,000 00 |
| d'Orsonnets, A.                              | 2 | B | "                       | 1,300 00 |
| Stronach, R. S.                              | 2 | B | "                       | 1,000 00 |
| Macdonald, J. A.                             | 3 | B | Clerk                   | 550 00   |
| Vacant                                       | 2 | B | Draughtsman             | 1,000 00 |
| Vacant                                       | 2 | B | "                       | 1,000 00 |
| Vacant                                       | 2 | B | "                       | 1,000 00 |

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## DRAUGHTING OFFICE—THIRD DIVISION.

*(Imperial Building, Queen Street.)*

COPYING plans for reproduction.

| Name.                           | CLASSIFICATION. |               | Duties of Office.            | Salary.  |
|---------------------------------|-----------------|---------------|------------------------------|----------|
|                                 | Division        | Sub-division. |                              |          |
|                                 |                 |               |                              | \$ cts.  |
| Engler, Carl, B.A., D.L.S. .... | 2               | A             | Chief of division.....       | 1,750 00 |
| May, J. E. ....                 | 2               | A             | Asst. chief of division..... | 1,600 00 |
| O'Connell, J. R. ....           | 2               | B             | Draughtsman.....             | 1,450 00 |
| Monle, W. J. ....               | 2               | B             | " .....                      | 1,350 00 |
| Helmer, J. D. ....              | 2               | B             | Clerk.....                   | 800 00   |
| Dawson, R. J. ....              | 2               | B             | " .....                      | 800 00   |
| Archambault, E. ....            | 2               | B             | " .....                      | 800 00   |
| Tremblay, A. ....               | 3               | B             | " .....                      | 750 00   |
| Brown, A. ....                  | 3               | B             | " .....                      | 650 00   |
| Binks, C. R. ....               | 3               | B             | " .....                      | 600 00   |
| Ebbs, E. J. ....                | 3               | B             | " .....                      | 500 00   |
| Watters, James. ....            | 3               | A             | Printer.....                 | 1,000 00 |
| Vacant.....                     | 3               | B             | Clerk .....                  | 500 00   |

## DRAUGHTING OFFICE—FOURTH DIVISION.

*(Metcalf Street, Corner of Slater.)*

SUPERVISING British Columbia surveys; preparing instructions; examining the returns and plotting the plans of the surveys.

|   |   |   |                              |          |
|---|---|---|------------------------------|----------|
| Rowan-Legg, E. L. ....                  | 2 | A | Chief of division.....       | 1,750 00 |
| Gillmore, E. T. B., Grad. R. M. C. .... | 2 | A | Asst. chief of division..... | 1,700 00 |
| Lawe, H., D.L.S. ....                   | 2 | A | " .....                      | 1,600 00 |
| MacIlquham, W. L., B. Sc. ....          | 2 | A | " .....                      | 1,600 00 |
| Morley, R. W. ....                      | 2 | A | " .....                      | 1,600 00 |
| Weld, W. E. ....                        | 2 | A | " .....                      | 1,600 00 |
| Wilson, E. E. D. ....                   | 2 | B | Draughtsman.....             | 1,400 00 |
| Osmund, H. ....                         | 2 | B | " .....                      | 1,000 00 |
| Harris, K. D. ....                      | 2 | B | " .....                      | 1,000 00 |

## DRAUGHTING OFFICE—FIFTH DIVISION.

*(Imperial Building, Queen Street.)*

COMPILING sectional maps and township index.

|                       |   |   |                              |          |
|-----------------------|---|---|------------------------------|----------|
| Smith, J. ....        | 1 | B | Chief of division.....       | 2,100 00 |
| Begin, P. A. ....     | 2 | A | Asst. chief of division..... | 1,650 00 |
| Genest, P. F. X. .... | 2 | A | " .....                      | 1,600 00 |
| Lepage, J. B. ....    | 2 | A | Draughtsman.....             | 1,600 00 |
| Blanchet, A. E. ....  | 2 | B | " .....                      | 1,450 00 |
| Davies, T. E. S. .... | 2 | B | " .....                      | 1,300 00 |
| Perrin, V. ....       | 2 | B | " .....                      | 1,300 00 |
| Davy, E. ....         | 2 | B | " .....                      | 1,100 00 |
| Flindt, A. H. ....    | 2 | B | " .....                      | 1,000 00 |
| Villeneuve, E. ....   | 2 | B | " .....                      | 800 00   |
| Bergin, W. ....       | 2 | B | " .....                      | 800 00   |

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## DRAUGHTING OFFICE—SIXTH DIVISION.

*(Imperial Building, Queen Street.)*

PLOTTING topographical plans; examining and plotting returns of levels on base lines; calculating and recording barometric elevations and magnetic observations; calculating astronomical field tables; testing and adjusting survey instruments.

| Name.                | CLASSIFICATION. |              | Duties of Office.      | Salaries. |      |
|----------------------|-----------------|--------------|------------------------|-----------|------|
|                      | Division        | Sub-division |                        | \$        | cts. |
| Dodge, G. B., D.L.S. | 1               | B            | Chief of division      | 2,100     | 00   |
| Vacant               | 2               | B            | Computer & draughtsman | 1,000     | 00   |
| Vacant               | 2               | B            | " "                    | 1,000     | 00   |
| Vacant               | 2               | B            | " "                    | 1,000     | 00   |
| Vacant               | 2               | B            | " "                    | 1,000     | 00   |
| Vacant               | 2               | B            | " "                    | 1,000     | 00   |
| Vacant               | 2               | B            | " "                    | 1,000     | 00   |
| Vacant               | 3               | B            | Clerk                  | 500       | 00   |
| Vacant               | 3               | B            | "                      | 500       | 00   |
| Vacant               | 3               | B            | "                      | 500       | 00   |
| Vacant               | 3               | B            | "                      | 500       | 00   |
| Vacant               | 3               | B            | "                      | 500       | 00   |
| Vacant               | 3               | B            | "                      | 500       | 00   |

## GEOGRAPHER'S OFFICE.

*(Wood's Building, Slater Street.)*

|                        |   |   |                  |       |    |
|------------------------|---|---|------------------|-------|----|
| White, James, F.R.G.S. | 1 | A | Chief Geographer | 3,600 | 00 |
| Chalifour, J. E.       | 1 | B | " draughtsman    | 2,100 | 00 |
| Baine, H. E.           | 2 | A | Draughtsman      | 1,850 | 00 |
| Tache, Henri           | 2 | A | "                | 1,600 | 00 |
| Anderson, W.           | 2 | A | "                | 1,600 | 00 |
| Bryant, E. D.          | 2 | A | "                | 1,600 | 00 |
| Inkster, Fred.         | 2 | A | "                | 1,600 | 00 |
| Beveridge, J.          | 2 | A | "                | 1,600 | 00 |
| Akerlindh, A.          | 2 | B | "                | 1,250 | 00 |
| Darrach, A. M.         | 2 | B | "                | 1,100 | 00 |
| Blatchley, H. M.       | 2 | B | "                | 1,050 | 00 |
| Dumouchel, G. E.       | 2 | B | "                | 1,050 | 00 |
| Grindlay, Thos.        | 2 | B | "                | 1,200 | 00 |
| Wilson, H. W.          | 2 | B | "                | 1,050 | 00 |
| Chandler, S.           | 2 | B | "                | 1,000 | 00 |
| Bennie, J.             | 2 | B | "                | 1,000 | 00 |
| Craig, R. W.           | 2 | B | "                | 1,600 | 00 |
| Groulx, A.             | 2 | B | "                | 900   | 00 |
| Gagnon, J. S.          | 2 | B | "                | 900   | 00 |
| McElligott, J. P.      | 2 | B | "                | 800   | 00 |
| Blue, W. A.            | 2 | B | "                | 800   | 00 |
| Pigeon, J. H.          | 2 | B | "                | 860   | 00 |
| Waite, Mrs. F. E.      | 3 | B | Clerk            | 700   | 00 |
| Martin, Miss M. P.     | 3 | B | Stenographer     | 600   | 00 |
| Stewart, Miss M.       | 3 | B | "                | 500   | 00 |
| Merrifield, J. R.      | 2 | B | Messenger        | 700   | 00 |
| Vacant                 | 2 | B | Draughtsman      | 800   | 00 |



SESSIONAL PAPER No. 25

SURVEY RECORDS OFFICE.

(Canadian Building, Slater Street.)

| Name.                                   | CLASSIFICATION. |              | Duties of Office.     | Salary.  |
|---|-----------------|--------------|-----------------------|----------|
|   | Division        | Sub-division |                       |          |
|   |                 |              |                       | \$ cts.  |
| Steers, C. J. ....                      | 2               | A            | Clerk in charge ..... | 1,700 00 |
| Currie, P. W., B.A., B.Sc., D.L.S. .... | 2               | A            | First assistant.....  | 1,750 00 |
| Surtees, W. S. ....                     | 2               | A            | Clerk.....            | 1,600 00 |
| Lecourt, Eugene.....                    | 2               | B            | Draughtsman.....      | 1,550 00 |
| Ashton, A. W., D.L.S. ....              | 2               | B            | " .....               | 1,250 00 |
| Gillis, W. C., L.Sc. ....               | 2               | B            | " .....               | 1,200 00 |
| Brice, E. E. ....                       | 2               | B            | " .....               | 1,000 00 |
| Smith, F. W. ....                       | 2               | B            | " .....               | 900 00   |
| Sawter, T. W. E. ....                   | 3               | A            | Clerk .....           | 1,100 00 |
| Belleau, Eugène, B.L. ....              | 3               | A            | " .....               | 1,100 00 |
| Lambart, O.H. ....                      | 3               | A            | " .....               | 1,100 00 |
| Yeilding, Miss A. E. ....               | 3               | A            | " .....               | 1,100 00 |
| Routh, C. T. ....                       | 3               | A            | " .....               | 960 00   |
| Moore, R. T. ....                       | 3               | B            | " .....               | 700 00   |
| Landry, Narcisse. ....                  | 3               | B            | " .....               | 600 00   |

GEOGRAPHIC BOARD.

(Woods Building, Slater Street.)

|  |   |   |                 |          |
|--|---|---|-----------------|----------|
| Whitcher, A. H., F.R.G.S., D.L.S. .... | 2 | A | Secretary ..... | 1,900 00 |
|--|---|---|-----------------|----------|

PHOTOGRAPHIC OFFICE.

(Metcalf Street, Corner of Slater Street.)

|                        |   |   |                           |          |
|------------------------|---|---|---------------------------|----------|
| Carruthers, H. K. .... | 2 | A | Process photographer..... | 1,600 00 |
| Woodruff, John .....   | 2 | A | Chief " .....             | 1,600 00 |
| Whitcomb, H. E. ....   | 3 | A | Photographer.....         | 1,000 00 |
| Morgan, W. E. ....     | 3 | A | " .....                   | 900 00   |
| Kilmartin, A. ....     | 3 | B | Asst. photographer.....   | 800 00   |
| Devlin, A. ....        | 3 | B | " .....                   | 800 00   |
| Onimet, E. G. ....     | 3 | B | Clerk.....                | 700 00   |

LITHOGRAPHIC OFFICE (Unclassified).

(Metcalf Street, Corner of Slater Street.)

| Name.                   | Occupation.         | Salaries.         |
|-------------------------|---------------------|-------------------|
| Moody, A. ....          | Foreman .....       | \$25 00 per week. |
| Burnett, E. ....        | Lithographer.....   | 25 00 "           |
| Thicke, C. R. ....      | " .....             | 22 00 "           |
| Deslauriers, J. H. .... | Transferrer.....    | 20 00 "           |
| Bergin, J. ....         | Printer.....        | 18 00 "           |
| Thicke, H. S. ....      | " .....             | 18 00 "           |
| Boyle, S. ....          | Stone polisher..... | 14 00 "           |
| Gagnon, J. ....         | Press feeder .....  | 11 00 "           |
| Kane, P. ....           | " .....             | 7 60 "            |

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## APPENDIX No. 11.

List of Dominion Land Surveyors who have been supplied with Standard Measures.

| Name.               | Address.                    | Date of Appointment. | Remarks.  |
|---------------------|-----------------------------|----------------------|---|
| Austin, G. F.       | Dewdney, Alta.              | April 14, 1872       |   |
| Aylen, J.           | North Bay, Ont.             | May 29, 1885         |   |
| Aylsworth, C. F.    | Madoc, Ont.                 | " 13, 1886           |   |
| Baker, J. C.        | Vermilion, Alta.            | " 18, 1906           |   |
| Baker, M. H.        | Maple Creek, Sask.          | Aug. 6, 1908         |   |
| Barwell, C. S. W.   | Dawson, Yukon Territory     | " 21, 1894           |   |
| Bayre, G. A.        | Winnipeg, Man.              | April 14, 1872       |   |
| Beatty, D.          | Parry Sound, Ont.           | " 14, 1872           |   |
| Beatty, W.          | Delta, Ont.                 | " 14, 1872           |   |
| Belanger, P. R. A.  | Ottawa, Ont.                | May 17, 1889         | Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.                                  |
| Belleau, J. A.      | "                           | " 15, 1883           | Topographical Surveys Branch, Dept. of Interior.  |
| Bigger, C. A.       | "                           | Mar. 30, 1882        | Astronomer, Dept. of Interior.  |
| Bingham, E. R.      | Fort William, Ont.          | Oct. 25, 1905        |   |
| Bolton, L.          | Listowel, Ont.              | April 14, 1872       |   |
| Boswell, E. J.      | Not known                   | Mar. 18, 1903        |   |
| Bourgeault, A.      | St. Jean Port Joli, Que.    | " 29, 1883           |   |
| Bourgault, C. E.    | "                           | Feb. 21, 1888        |   |
| Bourget, C. A.      | Levis, Que.                 | May 14, 1884         |   |
| Bowman, H. J.       | Berlin, Ont.                | Feb. 16, 1888        |   |
| Brabazon, A. J.     | Ottawa, Ont.                | May 13, 1882         |   |
| Brady, J.           | Golden, B.C.                | April 14, 1872       |   |
| Bray, S.            | Ottawa, Ont.                | Nov. 14, 1883        | Dept. of Indian Affairs.  |
| Bray, L. T.         | Amherstburg, Ont.           | Feb. 18, 1903        |   |
| Bridgland, M. P.    | Calgary, Alta.              | Mar. 10, 1905        | Topog. Surveys Branch, Dept. of Interior.   |
| Brownlee, J. H.     | Victoria, B.C.              | April 15, 1887       |   |
| Bucknill, W. B.     | Vancouver, B.C.             | Mar. 19, 1908        |   |
| Burke, W.           | Minnedosa, Manitoba.        | April 14, 1872       |   |
| Burnet, N.          | Ottawa, Ont.                | June 22, 1885        |   |
| Burwash, N. A.      | Whitehorse, Yukon Territory | Mar. 6, 1907         |   |
| Burwell, H. M.      | Vancouver, B.C.             | Feb. 17, 1887        |   |
| Campbell, A. S.     | Kingsston, Ont.             | Mar. 6, 1909         |   |
| Carbert, J. A.      | Medicine Hat, Alta.         | May 12, 1880         |   |
| Carpenter, H. S.    | Regina, Sask.               | Feb. 20, 1901        | Dept. of Public Works for Saskatchewan.   |
| Carroll, C.         | Prince Albert, Sask.        | April 14, 1872       |   |
| Carson, P. A.       | Ottawa, Ont.                | Feb. 22, 1906        | Topog. Surveys Branch, Dept. of Interior.   |
| Cautley, R. H.      | Edmonton, Alta.             | May 1, 1905          |   |
| Cautley, R. W.      | "                           | Sept. 2, 1896        |   |
| Cavana, A. G.       | Orillia, Ont.               | Nov. 16, 1876        |   |
| Charlesworth, L. C. | Edmonton, Alta.             | Mar. 24, 1903        | Dept. of Public Works, Alberta.   |
| Chilver, C. A.      | Walkerville, Ont.           | Feb. 22, 1907        |   |
| Christie, W.        | Chesley, Ont.               | Mar. 22, 1906        |   |
| Coates, P. C.       | Golden, B.C.                | April 19, 1907       |   |
| Cleveland, E. A.    | Vancouver, B.C.             | June 27, 1899        |   |
| Côté, J. A.         | Prince Albert, Sask.        | May 14, 1884         |   |
| Côté, J. L.         | Edmonton, Alta.             | Mar. 21, 1890        |   |
| Cotton, A. F.       | New Westminster, B.C.       | May 11, 1880         |   |
| Craig, J. D.        | Ottawa, Ont.                | Feb. 21, 1902        | Boundary Surveys, Dept. of Int.   |
| Cummings, A.        | Fernie, B.C.                | Mar. 3, 1902         |   |
| Cummings, J. G.     | Calgary, Alta.              | Feb. 17, 1904        |   |
| Dalton, J. J.       | Weston, Ont.                | April 17, 1879       | Dominion Topographical Surveyor.  |
| Davies, T. A.       | Ottawa, Ont.                | Feb. 22, 1906        |   |
| Deans, W. J.        | Brandon, Man.               | May 13, 1886         |   |
| Dennis, J. S.       | Calgary, Alta.              | Nov. 19, 1877        | Dominion Topographical Surveyor, Inspector of Irrigation and British Columbia Land Commissioner, C.P.R. |

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## APPENDIX No. 11.

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

| Name.            | Address.                    | Date of Appointment. | Remarks.   |
|------------------|-----------------------------|----------------------|--|
| Denny, H. C.     | Not known                   | April 1, 1882        |  |
| Dickson, H. G.   | Whitehorse, Yukon Territory | Mar. 19, 1899        |  |
| Dickson, J.      | Fenelon Falls, Ont.         | April 14, 1872       |  |
| Dobie, J. S.     | Regina, Sask.               | Mar. 22, 1906        | Dept. of Public Works for Saskatchewan.  |
| Doupe, J.        | Winnipeg, Man.              | April 14, 1872       |  |
| Doupe, J. L.     | "                           | Oct. 6, 1888         | Asst. Land Commissioner, C. P.R.   |
| Drewry, W. S.    | New Denver, B.C.            | Nov. 14, 1883        |  |
| Driscoll, A.     | Edmonton, Alta.             | Feb. 23, 1887        |  |
| Drummond, T.     | Montreal, Que.              | June 24, 1878        | Dominion Topographical Surveyor.   |
| Ducker, W. A.    | Winnipeg, Man.              | Mar. 30, 1883        | Swamp Land Commissioner.   |
| Dunais, P. T. C. | Hull, Que.                  | " 29, 1882           |  |
| Edwards, Geo.    | Ponoka, Alta.               | April 14, 1872       |  |
| Ellacott, C. H.  | Victoria, B.C.              | Feb. 22, 1899        |  |
| Empey, J. M.     | Calgary, Alta.              | " 23, 1905           |  |
| Fairchild, C. C. | Brantford, Ont.             | " 20, 1901           |  |
| Farncomb, A. E.  | Lacombe, Alta.              | Mar. 12, 1902        |  |
| Fawcett, T.      | Niagara Falls, Ont.         | Nov. 18, 1876        | Dominion Topographical Surveyor.   |
| Fawcett, A.      | Gravenhurst, Ont.           | Feb. 22, 1893        |  |
| Findlay, A.      | Winnipeg, Man.              | Mar. 21, 1908        |  |
| Fontaine, L. E.  | Levis, Que.                 | Nov. 30, 1892        | Inspector of surveys, Topographical Surveys Branch, Dept. of Interior.           |
| Foster, F. L.    | Toronto, Ont.               | April 14, 1872       |  |
| Francis, J.      | Poplar Point, Man.          | June 17, 1875        |  |
| Garden, J. F.    | Vancouver, B.C.             | May 13, 1880         |  |
| Garden, G. H.    | Lethbridge, Alta.           | April 14, 1872       |  |
| Garden, C.       | Not known                   | " 14, 1872           |  |
| Garner, A. C.    | South Qu'Appelle, Sask.     | May 27, 1907         |  |
| Gauvreau, L. P.  | Not known                   | April 14, 1872       |  |
| Gibbons, J.      | Dawson, Yukon Territory     | Feb. 12, 1891        |  |
| Gordon, M. L.    | Vancouver, B.C.             | " 18, 1904           |  |
| Gordon, R. J.    | Raymond, Alta.              | Mar. 12, 1902        |  |
| Gore, T. S.      | Victoria, B.C.              | April 19, 1879       |  |
| Green, A. H.     | Nelson, B.C.                | Feb. 23, 1905        |  |
| Green, T. D.     | Prescott, Ont.              | May 19, 1884         |  |
| Green, W. T.     | Ottawa, Ont.                | Feb. 22, 1907        | Topographical Surveys Branch, Dept. of Interior.                                 |
| Grover, G. A.    | Norwood, Ont.               | " 18, 1901           |  |
| Harris, J. W.    | Winnipeg, Man.              | April 14, 1872       | City Surveyor, Winnipeg.   |
| Harvey, C.       | Indian Head, Sask.          | Feb. 17, 1904        |  |
| Hawkins, A. H.   | Listowel, Ont.              | Mar. 6, 1906         |  |
| Heathcott, R. V. | Edmonton, Alta.             | May 13, 1907         |  |
| Henderson, W.    | Not known                   | Nov. 17, 1883        |  |
| Holerof, H. S.   | Toronto, Ont.               | Feb. 18, 1903        |  |
| Hopkins, M. W.   | Edmonton, Alta.             | " 20, 1901           |  |
| Hubbell, E. W.   | Ottawa, Ont.                | May 19, 1884         | Topographical Surveys Branch, Dept. of Interior President of D.L.S. Association. |
| James, S.        | Toronto, Ont.               | April 14, 1872       |  |
| Jephson, R. J.   | Brandon, Man.               | May 12, 1880         |  |
| Johnson, A. W.   | Kamloops, B.C.              | Mar. 12, 1900        |  |
| King, W. F.      | Ottawa, Ont.                | Nov. 21, 1870        | Dominion Topographical Surveyor, Chief Astronomer, Dept. of Interior.            |
| Kimpe, M.        | Edmonton, Alta.             | May 13, 1907         |  |
| Kirk, J. A.      | Revelstoke, B.C.            | " 11, 1880           |  |
| Kitto, F. H.     | Ottawa, Ont.                | Mar. 6, 1908         | Topographical Surveys Branch Dept. of Interior.                                  |
| Klotz, O. J.     | "                           | Nov. 19, 1877        | Dominion Topographical Surveyor, Astronomer, Dept. of the Interior.              |

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## APPENDIX No. 11.

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—Continued.

| Name.             | Address.                        | Date of Appointment. | Remarks.   |
|-------------------|---------------------------------|----------------------|--|
| Knight, R. H.     | Edmonton, Alta.                 | Feb. 18, 1904        |  |
| Latimer, F. H.    | Detroit, Mich.                  | Nov. 13, 1885        |  |
| Laurie, R. C.     | Battleford, Sask.               | April 27, 1885       |  |
| Lawe, H.          | Ottawa, Ont.                    | " 14, 1872           | Topographical Surveys Branch, Dept. of Interior.   |
| Lemoine, C. E.    | Quebec, Que.                    | Mar. 31, 1882        |  |
| Lendrum, R. W.    | Strathcona, Alta.               | May 15, 1880         |  |
| Loneragan, G. J.  | Buckingham, Que.                | Feb. 28, 1901        | Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.                   |
| Lunsden, H. D.    | Ottawa, Ont.                    | April 14, 1872       | Chief Engineer Trans. Ry.  |
| MacPherson, C. W. | Dawson, Yukon Territory.        | Mar. 7, 1900         | Director of Surveys, Y.T.  |
| Magrath, C. A.    | Lethbridge, Alta.               | Nov. 16, 1881        | Dominion Topographical Surveyor, Member of Parliament.                                   |
| Meadows, W. W.    | Maple Creek, Sask.              | Feb. 23, 1905        | District Surveyor and Town Engineer.   |
| Miles, C. F.      | Toronto, Ont.                   | April 14, 1872       | Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.                   |
| Moberly, H. K.    | Imnissail, Alta.                | " 21, 1903           |  |
| Molloy, J.        | Winnipeg, Man.                  | " 14, 1872           |  |
| Montgomery, R. H. | Prince Albert, Sask.            | Feb. 23, 1905        |  |
| Moore, H. H.      | Calgary, Alta.                  | Feb. 17, 1904        |  |
| Morrice, J. E.    | Ottawa, Ont.                    | May 16, 1907         |  |
| McArthur, J. J.   | Ottawa, Ont.                    | April 17, 1879       | Boundary Surveys, Dept. of Interior.   |
| McCull, G. B.     | Winnipeg, Man.                  | Mar. 20, 1907        | Dominion Topographical Surveyor.   |
| McDiarmid, S. S.  | Vancouver, B.C.                 | Feb. 23, 1905        |  |
| McFadden, M.      | Neepawa, Man.                   | April 14, 1872       |  |
| McFarlane, J. B.  | Toronto, Ont.                   | June 3, 1908         |  |
| McFarlane, W. G.  | Toronto, Ont.                   | May 19, 1905         |  |
| McFee, A.         | Red Deer, Alta.                 | April 19, 1879       |  |
| McGrandle, H.     | Weta-kiwin, Alta.               | May 30, 1883         |  |
| McKenna, J. J.    | Dublin, Ont.                    | April 14, 1872       |  |
| McKenzie, J.      | New Westminster, B.C.           | Nov. 18, 1887        | Dominion Lands Agent, New Westminster.   |
| McLean, J. K.     | Ottawa, Ont.                    | April 1, 1882        | Dept. of Indian Affairs.   |
| MacLennan, A. L.  | Toronto, Ont.                   | Feb. 23, 1905        |  |
| McMillan, G.      | Ottawa, Ont.                    | " 22, 1906           |  |
| McPherson, A. J.  | Dawson, Yukon Territory.        | " 21, 1901           |  |
| McPhillips, G.    | Winnipeg, Man.                  | June 17, 1875        |  |
| McVittie, A. W.   | Blairmore, Alta.                | Mar. 30, 1882        |  |
| Nash, T. S.       | Ottawa, Ont.                    | Feb. 18, 1904        | Topographical Surveys Branch, Dept. of Interior, secretary-treasurer of the D.L.S. Assn. |
| Ogilvie, W.       | Paris, Texas.                   | April 14, 1872       |  |
| O'Hara, W. F.     | Ottawa, Ont.                    | Feb. 19, 1895        |  |
| Ord, L. R.        | Hamilton, Ont.                  | April 1, 1882        |  |
| Parsons, J. L. R. | Regina, Sask.                   | Feb. 23, 1905        |  |
| Patrick, A. P.    | Calgary, Alta.                  | Nov. 19, 1877        | Dominion Topographical Surveyor.   |
| Pearce, W.        | Calgary, Alta.                  | May 10, 1880         |  |
| Phillips, E. H.   | Saskatoon, Sask.                | Feb. 24, 1902        | Dept. of Public Works for Saskatchewan.  |
| Plunkett, T. H.   | Meaford, Ont.                   | Mar. 12, 1908        |  |
| Ponton, A. W.     | Macleod, Alta.                  | May 18, 1881         |  |
| Proudfoot, H. B.  | Saskatoon, Sask.                | Mar. 28, 1882        |  |
| Rainboth, E. J.   | Ottawa, Ont.                    | May 19, 1881         |  |
| Rainboth, G. C.   | Aylmer, Que.                    | April 14, 1872       | Boundary Surveys, Dept. of Interior.   |
| Reid, J. L.       | Ottawa, Ont.                    | " 14, 1872           | Dept. of Indian Affairs.   |
| Reilly, W. R.     | Regina, Sask.                   | Nov. 17, 1881        |  |
| Richard, J. F.    | Ste. Anne de la Pocatiere, Que. | May 13, 1882         |  |
| Rinfret, R.       | Quebec, P.Q.                    | Feb. 20, 1900        |  |
| Ritchie, J. F.    | Nelson, B.C.                    | Jan. 7, 1889         |  |

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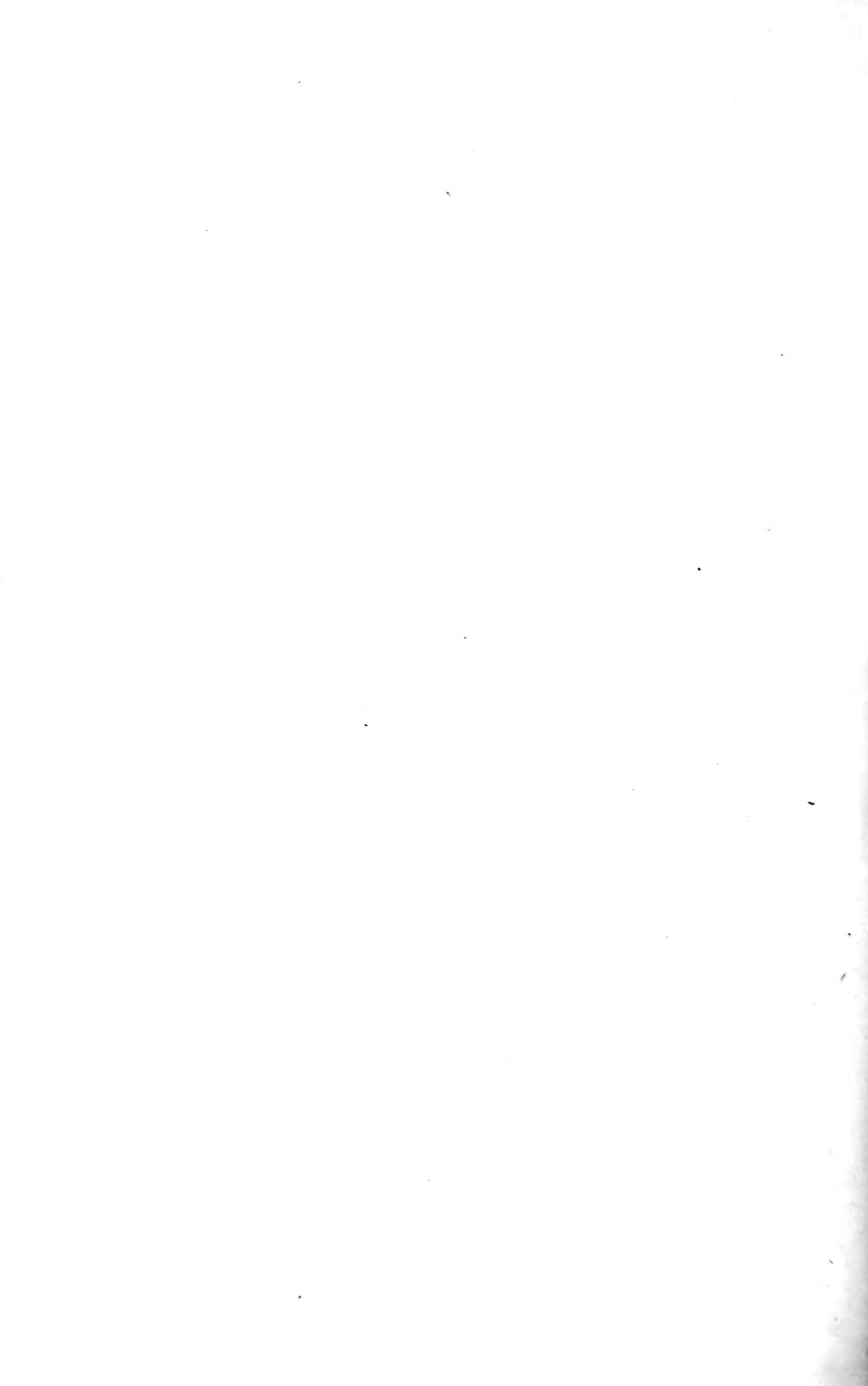
## APPENDIX No. 11.

List of Dominion Land Surveyors who have been supplied with Standard Measures — *Concluded.*

| Name.                  | Address.               | Date of Appointment. | Remarks.  |
|------------------------|------------------------|----------------------|---|
| Robertson, H. H.       | Not known              | April 13, 1872       |   |
| Roberts, S. A.         | Victoria, B.C.         | May 16, 1885         |   |
| Roberts, V. M.         | Sturgeon Falls, Ont.   | " 17, 1886           |   |
| Robinson, E. W.        | Victoria, B.C.         | " 1, 1908            |   |
| Robinson, F. J.        | Regina, Sask.          | Feb. 20, 1906        | Dept. of Public Works for Saskatchewan.   |
| Rolfson, O.            | Walkerville, Ont.      | July 11, 1908        |   |
| Roumough, M. B.        | Morden, Man.           | April 14, 1872       |   |
| Rorke, L. V.           | Toronto, Ont.          | Aug. 13, 1891        |   |
| Ross, G.               | Welland, Ont.          | Nov. 21, 1882        |   |
| Ross, J. E.            | Kamloops, B.C.         | Feb. 22, 1891        |   |
| Roy, G. P.             | Quebec, Que.           | Nov. 17, 1881        |   |
| Saint Cyr, J. B.       | Montreal, Que.         | Feb. 17, 1887        |   |
| Saint Cyr, A.          | Ottawa, Ont.           | " 1, 1887            |   |
| Saunders, B. J.        | Edmonton, Alta.        | Nov. 16, 1884        |   |
| Scott, W. A.           | Galt, Ont.             | Mar. 19, 1909        |   |
| Seagar, E.             | Kenora, Ont.           | April 14, 1872       |   |
| Selby, H. W.           | Toronto, Ont.          | Nov. 15, 1882        |   |
| Seymour, H. L.         | Edmonton, Alta.        | Feb. 22, 1906        |   |
| Swell, H. de Q.        | Toronto, Ont.          | May 16, 1885         |   |
| Shaw, C. A. E.         | Victoria, B.C.         | " 19, 1880           |   |
| Shelley, J. D.         | Maple Creek, Sask.     | Mar. 12, 1906        |   |
| Smith, C. C.           | Ottawa, Ont.           | Feb. 22, 1906        | Dominion Observatory, Dept. of Interior.  |
| Speight, Thos.         | Toronto, Ont.          | Nov. 16, 1882        |   |
| Starkey, S. M.         | Starkey's P. O., N.S.  | April 14, 1872       |   |
| Steele, I. J.          | Ottawa, Ont.           | " 16, 1908           |   |
| Stewart, G. A.         | Calgary, Alta.         | " 14, 1872           |   |
| Stewart, L. B.         | Toronto, Ont.          | Nov. 22, 1882        | Dominion Topographical Surveyor, Professor of Surveying, School of Practical Science. |
| Stewart, E.            | Montreal, Que.         | April 14, 1872       |   |
| Stewart, W. M.         | Hamilton, Ont.         | June 6, 1907         |   |
| Talbot, A. C.          | Calgary, Alta.         | May 13, 1889         |   |
| Taylor, A.             | Not known              | June 9, 1904         |   |
| Teasdale, C. M.        | Concord, Ont.          | Mar. 9, 1906         |   |
| Thompson, W. T.        | Fort Qu'Appelle, Sask. | Nov. 19, 1877        | Dominion Topographical Surveyor.  |
| Tracy, T. H.           | Vancouver, B.C.        | April 14, 1872       | City Engineer, Vancouver.   |
| Trenblay, A. J.        | Les Eboulements, Que.  | Feb. 18, 1890        |   |
| Turnbull, T.           | Winnipeg, Man.         | Mar. 29, 1882        |   |
| Tyrell, J. W.          | Hamilton, Ont.         | Feb. 16, 1887        |   |
| Vaughan, J. W.         | Vancouver, B.C.        | June 11, 1878        |   |
| Vicars, J.             | Kamloops, B.C.         | May 17, 1886         |   |
| Waddell, W. H.         | Hamilton, Ont.         | Mar. 25, 1907        |   |
| Waldron, J.            | Moosejaw, Sask.        | April 2, 1907        |   |
| Walker, E. W.          | Regina, Sask.          | Mar. 27, 1907        | Dept. of Public Works for Saskatchewan.   |
| Wallace, J. N.         | Calgary, Alta.         | Feb. 20, 1900        |   |
| Warren, J.             | Walkerton, Ont.        | April 14, 1872       |   |
| Watt, G. H.            | Prince Albert, Sask.   | Feb. 24, 1902        |   |
| Weekes, A. S.          | Edmonton, Alta.        | " 11, 1892           |   |
| Weekes, M. B.          | Regina, Sask.          | " 18, 1903           | Dept. of Public Works for Saskatchewan.   |
| Wheeler, A. O.         | Calgary, Alta.         | Nov. 21, 1882        | Topographer of the Department of the Interior.  |
| White-Fraser, G. W. R. | Ottawa, Ont.           | Feb. 21, 1888        | Dominion Topographical Surveyor.  |
| Wiggins, T. H.         | Saskatoon, Sask.       | " 18, 1896           |   |
| Wilkins, F. W.         | Norwood, Ont.          | May 18, 1881         | Dominion Topographical Surveyor.  |
| Wilkinson, W. D.       | Not known              | Feb. 22, 1893        |   |
| Williams, G. L.        | Vancouver, B.C.        | June 24, 1908        |   |
| Woods, J. E.           | Frank, Alta.           | Nov. 14, 1885        |   |
| Young, W. B.           | Winnipeg, Man.         | Mar. 25, 1905        |   |
| Young, W. H.           | Lethbridge, Alta.      | May 17, 1907         |   |









PART V  
DOMINION PARKS



# DOMINION PARKS

## REPORT OF THE COMMISSIONER OF DOMINION PARKS.

DEPARTMENT OF THE INTERIOR,

BANFF, ALBERTA, July 15, 1909.

To the Honourable FRANK OLIVER,

Minister of the Interior,

Ottawa, Ont.

SIR,—I have the honour to submit herewith my first annual report as commissioner of Dominion parks for the fiscal year ending March 31, 1909.

It is a source of very great pleasure to me to be able to report that with each succeeding year the popularity of Canada's western recreation grounds is increasing with rapidity that has far exceeded the most sanguine expectations of those who a few years ago saw the immense possibilities of these parks as a pleasure and health resort. The usefulness of these parks is becoming more and more recognized as they become better known, and their future development and expansion will, it is expected, be much more rapid than in the past. The remarkable growth of interest manifested in these charming resorts is not only very marked in the increasing number of temporary summer visitors and tourists, but in the rapidly increasing numbers of permanent residents in the town of Banff. The presence of an up-to-date school of three rooms in charge of a competent staff of teachers and fully equipped with modern educational facilities, is having the effect of inducing many families to take up their residence in Banff for a part of each year.

During the past ten years there has been an increase of almost five hundred per cent in the number of visitors to the different mountain parks, as may be seen by the comparative figures compiled for each year since 1899, which are as follows:—

| Year.                | No. of Visitors. |
|----------------------|------------------|
| 1899.....            | 7,389            |
| 1900.....            | 6,533            |
| 1901.....            | 8,456            |
| 1902.....            | 8,516            |
| 1903.....            | 10,696           |
| 1904.....            | 11,752           |
| 1905.....            | 17,605           |
| 1906.....            | 30,136           |
| 1907 (9 months)..... | 288,735          |
| 1908.....            | 32,209           |
| 1909.....            | 39,780           |

In the above figures I have not included the very large number of persons who visit the parks on excursions for a day and who do not register at the hotels, &c. Among the visitors were people from almost every country of the world, no less than forty-five different nationalities being represented last year. I may say that every one of them has gone away charmed and delighted with the scenic wonders of Canada's national parks.

During the past year the parks were visited by an unusually large number of British, eastern Canadian and American press associations and delegations consisting of many of the leading magazine and newspaper writers in those countries. On their return home well-written leading articles descriptive of the grandeur of the mountains,

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valleys, waterfalls, caves and other wonders which they saw, made known to hundreds of thousands of their readers that Canada has beauty spots to make men happy as well as fertile plains to make them wealthy.

They were also particularly impressed with the cosmopolitan character of the people met at the different resorts in the park. One of them, an extensively travelled and leading newspaper writer of New York, remarked: 'Between New York and Shanghai, where I spent five years, there is no spot more cosmopolitan than the rotunda of the Canadian Pacific Hotel at Banff.' After noting some of the men that he had met in far distant parts of the world and whose acquaintance he had renewed on his visit to Banff, he said: 'The women in this group of people in the rotunda of the hotel are dressed as attractively as any women in any hotel in the world, and when the orchestra plays and the people move about talking to each other I could imagine myself in Buenos Ayres, in Bombay, in Melbourne, in Malta, in Cape Town or in any other city in which the currents of world traffic come together.'

The tide of travel for the season of 1909 has commenced in an unprecedented volume, and already the accommodation of the parks is taxed to its utmost limit, and judging from present indications it is confidently expected that it will be almost double in volume that of any former year. This is due in a great measure to the crowds of people from eastern Canada, the eastern and New England states who are visiting the Alaska-Yukon Exposition at Seattle, and are taking advantage of the opportunity of seeing the magnificent scenery of the Canadian mountains, either on their going or homeward trip. A very large percentage of these stop off for a day or two and many of them for a longer period at some of the resorts in the mountain parks. The task of providing for the comfort and accommodation of so many of these pleasure-seekers, in addition to the regular number of visitors and tourists, necessarily involves a large amount of extra work for the staff at each park.

#### THE TOWN OF BANFF.

The town of Banff, the business centre of the Rocky Mountains Park and the chief objective point for tourists, is an up-to-date little town of close to one thousand permanent residents, which is generally increased to about fifteen hundred during the summer months by temporary residents who either own or lease cottages which they occupy from two to six months each year.

Eight excellent hotels and six livery barns well supplied with saddle horses and carriages cater to the tourist and other trade for trips to the many points of interest to which roads and trails lead from the town. Outfitting stores of all kinds furnish supplies to the residents or camping parties at reasonable prices.

The town is supplied with all modern utilities in the way of electric light, water and sewer systems, telephone exchange connected with the Alberta government long-distance telephone system, churches, schools, fraternal societies, athletic and social clubs, &c.

The principal streets are all well graded and gravelled, but a large amount of work is required to be done each year in keeping up new streets where new houses are being built, extending to water and sewer system, regrading streets which are torn up by the extension of the water works and sewer system.

#### OTHER IMPROVEMENTS IN THE PARK.

In addition to the large amount of necessary work done last year in the maintenance and repair of the roads and trails in the town of Banff and other parts of the park a considerable amount of new work was undertaken. In the town about a mile of street was regraded and gravelled and a cinder path constructed from the Bow River bridge to the Banff Springs Hotel, a distance of about three-quarters of a mile.

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Six miles of new road was constructed between Canmore and Exshaw, to facilitate communication by rigs between those two points. This new road will also form a part of the proposed coach road from Calgary to Banff, on its part of which the provincial government of Alberta is doing a considerable amount of work each year. It is expected that the road for this entire distance will be completed in another year and made passable for all kinds of vehicles.

Three miles of road were built as an extension of the road from Laggan to Moraine lake in the valley of the Ten Peaks. It is hoped to have the remaining three miles of this road to the lake completed this year.

With the additions made during the past year there are now in operation and in a good state of repair nearly eighty miles of carriage road at Banff, nineteen miles at Laggan, and thirty-five miles at Field.

I am glad to be able to report that notwithstanding the greatly increased travel over them there has not been a single serious accident or any unnecessary delay on any of them.

## THE MUSEUM AND GROUNDS.

The number of visitors to the museum as shown by the report of the curator (which is appended), continues to increase each year and is one of the chief attractions of the park. The different specimens of the big game, the smaller mammals, the fish and bird-life, the flora and minerals of the park are proving a continued source of interest to the lay visitor as well as to the student of natural science. Its educative value in enabling the visitors to classify the different specimens of plants and rocks which they find in their tours is greatly appreciated, so much so that an appreciative visitor styled it 'The University of the Hills.'

To the younger generation of the visitors the mounted specimens of wild animals, birds and insects and the caged live animals are a source of great interest and delight. The additions to the specimens last year included the head of an elk which was killed in a fight with another elk, some birds, &c.

The wild animals confined in the new cages have been in perfectly good health and condition during the year, and have taken very kindly to their enforced captivity in their new homes and appear to enjoy their comfortable and clean environments. The animals confined in them at present are :—

|                     |   |
|---------------------|---|
| Black bear.....     | 1 |
| Brown bear..        | 1 |
| Cinnamon bear.....  | 1 |
| Mountain lions..... | 1 |
| Timber wolves.....  | 2 |
| Coyotes.....        | 2 |
| Kit fox.....        | 3 |
| Red fox.....        | 2 |
| Lynx.....           | 2 |
| Raccoons.....       | 2 |
| Badgers.....        | 2 |
| Marmots.....        | 2 |

During the year a considerable amount of work was done on the grounds to make it more convenient and comfortable for visitors to see the animals in captivity. This included the completion of a gravelled drive around the grounds, a cinder path between and around the cages, fencing, levelling, draining and filling low ground, &c.

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## THE SULPHUR BATHS.

The revenue from the baths at the Cave and Basin continues steadily to increase and the number of bathers who enjoyed their beneficent and curative waters during the past year was greatly in excess of that of any previous year since the baths were opened. This was the case, notwithstanding the growing popularity of the baths at the Hot Springs.

In my report of last year I drew your attention to the inadequacy of the accommodation at the Cave and Basin for the swarms of bathers who patronize it especially during the months of July and August. Intending bathers have in many cases every day during these months to wait for a considerable length of time before they can secure a dressing room.

At the Hot Springs baths the lack of sufficient accommodation is even more apparent. At no season of the year can the number of bathers be satisfactorily accommodated and during the hot summer months large numbers of intending bathers are, owing to the lack of accommodation, unable to secure baths.

The erection of a large up-to-date bath-house at the Hot Springs, equipped with all the latest modern conveniences is imperative if the baths are to continue to increase in popularity, as no doubt they will. In my opinion the revenue would increase in proportion to the expenditure and be a good paying investment for the department.

It may be of interest to the public to reproduce the report of the analyst of the Canadian government, who says officially:—

'The water is free from organic impurities and gives no albuminoid nitrogen. Each gallon contains dissolved sulphuretted hydrogen to the amount of 0.3 grains (equivalent to 0.8 cubic inch).

'The dissolved solids are as follows:—

|  |                  |
|--|------------------|
| 'Chloride (in chlorides).....              | 0.42 grains.     |
| 'Sulphuric acid (SO <sub>3</sub> ).....    | 38.50 "          |
| 'Silica (SiO <sub>2</sub> ).....           | 2.31 "           |
| 'Lime (CaO).....                           | 24.85 "          |
| 'Magnesia (Mg).....                        | 4.87 "           |
| 'Alkalis (as Seda, Na <sub>2</sub> O)..... | 0.62 "           |
| 'Lithium .....                             | a decided trace. |

'The temperature of the spring is 114.3 degrees Fahrenheit.'

During the year a large number of complete and permanent cures of diseases, especially of rheumatism and other blood diseases, were reported as a result of the curative qualities of the Banff sulphur water baths.

## ANIMALS IN THE PADDOCKS.

The animals in the paddocks at Banff continue to be one of the most popular of the attractions in the park and the caretaker's register shows a largely increased number of visitors each year. Especial interest is taken by them in the herd of buffalo, as being the relics of the countless monarchs of the plains, which but for the action of the Interior Department of the government of Canada would have been doomed to total extinction.

That there has not been a large natural increase during the year is accounted for by the fact that the paddock in which they are inclosed has become entirely too small for such a large herd and the animals are too much crowded for successful breeding. It is my intention during this year to have the majority of them removed to one of the large buffalo parks, leaving about twenty-five or thirty head at Banff. This number will be quite sufficient for the purpose for which the animals are kept at Banff

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The small increase in the number of the other animals is due almost entirely to the destruction of their young by coyotes and wolves. A wire inclosure to keep out these carnivorous and destructive animals will be built during the year, which will ensure the protection of the young animals from their enemies. It is only by experience that the best way of caring for wild animals in such partial captivity and under such circumstances can be learned and this appears to me to be the best way of protecting them.

It is with regret that I have to report the death of 'Sir Donald,' the patriarch of the buffalo herd, whose tragic end occurred early in March, he having been gored to death by a number of young buffalo bulls.

For several years it had been the intention to preserve and take the best of care of 'Sir Donald' as a matter of scientific historical interest in ascertaining the longevity of the buffalo race. For that reason he was cared for until he became too decrepit from age to care for himself. When he was attacked by the younger bulls and knocked down, he was helpless to defend himself and the aged hero was gored and trampled beyond recognition, in which condition he was found next morning. There is not the slightest doubt but that 'Sir Donald' was the last specimen of the buffalo that a few years ago roamed the prairie at will in their wild free state. He was captured as a buffalo calf by the Indians in 1872 and was consequently in his thirty-eighth year at the time of his death. His history during his thirty-seven years of captivity has been one of romantic interest to thousands of people as the sole survivor of a noble type of animals, that in their wild state have become only a memory to Indians, buffalo hunters and old-time white pioneers.

Shortly after his capture he was sold by the Indians to Mr. James McKay, then chief factor for the Hudson's Bay Company at Fort Garry, and afterwards became a part of and headed the herd of Sir Donald A. Smith (now Lord Strathcona) at Silver Heights. In 1898 Lord Strathcona donated the remnant of his herd, consisting of thirteen animals, among which was 'Sir Donald,' to the National Park at Banff, to be cared for as the wards of the Canadian government.

It had been intended to have the skin preserved and mounted as a whole specimen for the new national museum at Ottawa, but unfortunately his carcass was so gored and disfigured beyond recognition that this was impossible. The head has, however, been preserved and is now being mounted and will serve in a measure as a memento of the last and noblest specimen of the buffalo of the by-gone days.

The animals now in the paddocks are as follows :—

|                         |     |                    |    |
|-------------------------|-----|--------------------|----|
| Buffalo.. . . . .       | 107 | Increase.. . . . . | 14 |
| Moose.. . . . .         | 21  | " .. . . . .       | 3  |
| Elk.. . . . .           | 15  | " .. . . . .       | 3  |
| Mule deer.. . . . .     | 11  |                    |    |
| Persian sheep.. . . . . | 3   |                    |    |
| Angora goats.. . . . .  | 6   |                    |    |
| Virginia deer.. . . . . | 4   |                    |    |

The only antelope in the paddock was killed during the year by another deer.

## THE COAL MINES.

The coal mines at Bankhead and Canmore have been in operation for almost full time during the year and the companies report a largely increased output over any former year in their history.

The capacity of the briquetting plant at Bankhead has been almost doubled owing to the rapidly increasing demand, and briquette bricks are largely used for steam purposes on the Western Division of the Canadian Pacific Railway. The Bankhead coal is the only anthracite coal found in western Canada.

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The high pressure air lines have been extended further into the mines and additional charging stations are being installed for the motors used in hauling the newly mined coal to the breakers. New workings are being driven north and south from the new slope below the tunnel level and the force of miners is being continually increased. As a consequence of this development and the employment of so many men in the mines, the town is in a prosperous condition and is rapidly increasing in size and population.

Considering that so many foreigners are employed, law and order are well observed and there is very little cause of complaint on this score.

At Canmore a new shaft, which almost doubles the capacity of the mines, was opened during the year about three miles east of the old shaft and the coal is mined from it.

A ready market is always available for the increasing tonnage mined owing to the fact that the Canadian Pacific Railway Company has contracted ahead for the total output of the mines. Canmore coal is considered the best steam coal on the entire Canadian Pacific Railway system and is largely used on the locomotives between Medicine Hat and Revelstoke.

#### PRESERVATION OF GAME AND TIMBER.

At the last session of parliament provision was made for the employment of three game and fire wardens and for combining the duties in connection with the protection of game and the prevention of forest fires in the Rocky Mountains Parks. These appointments have been made and the new wardens will enter on their duties with the beginning of the fiscal year.

They will patrol all portions of the parks and regular patrol trails and small cabins will be constructed in different portions of the parks where the men can remain over night and avoid the necessity of packing tents, &c., with them. Each will be furnished with a saddle pony and a pack pony carrying supplies, so that they can remain out for several days at a time or as long as their patrol duty in any locality may require. By this means it is hoped that the killing of game by the Indians and tourists, which in the past was not of uncommon occurrence in the outlying portions of the parks owing to insufficient patrol, may be checked if not altogether prevented.

The adoption of the proposed new regulations prohibiting the carrying of unsealed firearms by persons within the limits of the parks should also have a beneficial effect in the way of minimizing the temptation to shoot and kill game in the park.

The wild animals appear to be increasing in numbers, and the regulation prohibiting dogs running at large within the parks will doubtless have the effect of making the animals less timid at the approach of mankind and less fearful of their mortal enemies, dogs and guns.

The question of the prevention of forest fires in the parks is also very serious, and one which causes a great deal of anxiety, especially during the dry months of July and August. During the past year the expense in connection with fighting forest fires was much greater than in former years, but this additional expense was counterbalanced many times over by the saving from destruction of large quantities of fine valuable timber. The instituting of a systematic patrol and the adoption of more stringent regulations in respect to the care of camp-fires by tourists should have the effect of greatly reducing the danger from this source and assist us in the effort to preserve the forests of the parks in the state of primeval nature which is one of their chief charms.

#### THE ALPINE CLUB OF CANADA.

The Canadian Alpine Club, the headquarters of which is at Banff, was permanently organized three years ago and has at present a membership of over five hundred, among whom are numbered some of the most distinguished and enthusiastic mountain climbers in the world.



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A very successful camp was held last year, and under the able direction of Mr. A. O. Wheeler, F.R.G.S., president of the club, a number of difficult ascents, as far as known never previously attempted, were successfully accomplished. At the camp of last year all the leading alpine clubs of Europe and American were represented by experienced and ardent scalers of mountain peaks.

Membership in the club is divided into five grades: Honorary, consisting of persons distinguished in mountaineering, exploration or research; associates, who may be active members or may not but who contribute twenty-five dollars to the club's treasury; active members, who have made an ascent of at least ten thousand feet in some recognized alpine region or who have contributed to Canadian alpine literature by scientific publications based on personal experience; and grading members, who are given two years to qualify as active members.

Funds have been raised for the erection of a commodious up-to-date club-house at Banff, for the accommodation of the executive and members, which will be completed in time for the annual meeting of the club in July, 1909. The site selected is on the slope of the Sulphur mountain, near the middle hot springs and commands a magnificent view of the town of Banff, the Bow river and valley and of the surrounding mountains.

The club-house and tents to be erected by the club will furnish comfortable and commodious accommodation for over seventy-five persons.

It is also the intention of the club to build during the coming summer a smaller club-house at Lake O'Hara and later on houses in different localities in the park.

The scope of the work of the club is not confined entirely to climbing mountains during the summer camps, but to stimulate the members to do all in their power to promote the extension of knowledge of the scenic and other wonders to be found only in the Canadian Rockies and Selkirk mountains.

## REVENUE OF THE PARK.

In my report of last year attention was drawn to the steady and continuous increase in the revenues of the park from nearly every source, and to the fact that the increase in appropriations by parliament for the extension of new work has not kept pace with the increase of revenue. It was estimated last year that over one and a quarter millions of dollars were spent in Canada by the tourists from foreign countries who visited the Rocky Mountains Parks, and it is expected that this amount will be almost, if not quite, doubled during the season of 1909.

The value of the parks as an asset of the Dominion of Canada cannot be measured by immediate results in dollars and cents, but they have been the means of spreading the fame and beauty of Canada to parts of the world where it otherwise would have been unheard of. Hundreds of visitors have said that they were induced to visit the Rocky Mountains Park through reports of its beauties given by tourists who had been there in former years. Its benefit to the Dominion of Canada, as a whole, as an advertising medium in the Department of Immigration alone, is of inestimable value, and it is doubtful if equal results for the money expended could be secured by any other means. Every additional dollar of expenditure on the national parks in the way of building and improving trails, carriage roads, bridges, &c., for the opening up of new points of interest and for making those already opened up more accessible, would, in my opinion, be money well invested and return a hundredfold in benefit to the country.

## YOHO PARK.

During the past year about three miles were added to the carriage road up the Yoho valley leading to Takakkaw falls. In this were the most difficult portions of the road, including considerable heavy rock work and a coup'le of switch-backs put in to

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make the grade of the ascent easier. From the summit of the second switchback a magnificent view of the river valley below and Cathedral mountain in the back ground is obtained. From this point it is intended as soon as possible to construct a foot-path through the undergrowth to the river canyon about one hundred yards distant, and to have a number of rustic seats placed for the convenience and accommodation of tourists who will avail themselves of the opportunity of visiting this wonderful view. The narrow canyon is over one thousand feet deep, walled in on either side by almost perpendicular rock walls. Tourists from all parts of the world have pronounced this valley one of the most beautiful they had ever seen and the carriage road one of the best of mountain roads. When the remaining three and a half miles of extension to the falls is completed (which we hope to have done early in August) the drive will be one of the pleasanter and most beautiful in the entire Rocky Mountains Parks and cannot fail to prove of annually increasing popularity.

The Takakkaw Falls, themselves one thousand four hundred and sixty feet in height, are among the wonders of the world, far surpassing in grandeur, if not in volume of water, the famed Niagara Falls or the falls of the Yellowstone Park. Where necessary the road has been gravelled and a great many small bridges built across the small streams that rush down the mountain sides from the glaciers above. The completion of the Yoho valley carriage road will overcome the arduous climb over the summit on the trail from Emerald lake to the falls.

The right of way for a carriage road from the Emerald lake road to the natural bridge over the Kicking Horse river, two miles in length, was cleared during the year and the work of grading the road will be commenced on the completion of the Yoho valley road.

This natural wonder is about three miles from Field and at present is reached only by a foot-path, and the construction of a carriage road will afford visitors an opportunity of visiting this beautiful spot over a short and pleasant driveway.

In addition to this, considerable repair work was done on the Emerald lake and Ottetail carriage roads, in cleaning out culverts and ditches, rendered necessary by the spring snow and mud slides which are usual in all mountain regions. These roads were kept in good condition from their opening up in the spring until they were closed for the winter and necessarily entailed considerable labour and expense.

Repairs were also made to the pack trail from Hector station to Lake O'Hara along the valley of Cataract creek. The opening up and making easy of access of these new places of interest in the Yoho Park is having the effect of largely increasing the number of tourists who spend some time at the different resorts as may be seen by the records of the registers at the different hotels in another part of this report.

#### GLACIER PARK.

At Glacier Park most of the new work outlined in my report of last year was undertaken, in addition to the repair work which is necessary to maintain the trail from Glacier House, which suffers every year from slides. At the Caves, the ladders at the more dangerous places in the descent were replaced by wooden stairways and railings, the lumber for which was packed on ponies from the railway to the Caves. This improvement was deemed necessary in order that accidents to nervous visitors might be averted and to make access to the Caves easier by all classes of people. During the year over one thousand people visited and explored the Caves, and every one returned enchanted with the wonders they had seen in these quaint rock caverns eaten out by the water action of centuries.

The Cascade trail and the Asulkan Valley trail are also becoming very popular with tourists who linger for a few days at the Glacier House and wish to make easy excursions among the beautiful scenery in that vicinity.

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To the more ambitious the ascents of Mounts Abbott and Sir Donald offer ample opportunity for the powers of the most ardent mountain climbers.

I hope during the coming year to complete the trail mentioned in my report of last year connecting the trail from Rogers Pass to the head waters of Bear creek with the end of the present trail at the Caves. This will make a good trail for the round trip of about fifteen miles from Glacier House at a comparatively small cost, which will be of great interest and pleasure to tourists.

## ELK ISLAND PARK.

Elk Island Park, with an area of sixty-four square miles, is located along the Canadian Northern Railway at Lamont Station, about forty miles east of Edmonton, in the Beaver Hills.

This park was originally acquired by the Alberta provincial government as a forest and game preserve. When the first and second shipments of buffalo were made from Montana in 1907 there was no other place to put them, consequently permission was obtained from the provincial government to range them in this park until such time as a larger and more suitable range could be acquired by the Dominion government. These two shipments numbered four hundred and ten head and have since temporarily ranged in the Elk Island Park.

When I was appointed commissioner of Dominion parks in 1908, this park was placed under my jurisdiction, but it is the intention during the present year to remove the buffalo to the new Buffalo Park which will be their future home, leaving about thirty-five head in the Elk Island Park to serve as the nucleus of another herd.

There are also in the park a considerable number of elk and deer, it being the natural home of these animals; when the fence was built they were inclosed in the park.

## BUFFALO PARK.

The new Buffalo Park reserved by the Dominion government in 1907 as a grazing range contains four hundred and thirty square miles. It is located in townships 42, 43 and 44, ranges 6, 7, 8 and 9 west of the fourth principal meridian on the Grand Trunk Pacific Railway about one hundred and twenty miles east of Edmonton. The northern end of the park is within one-half mile of Wainwright, a railway divisional point and the southern boundary three miles from Rosyth station, on the Wetaskiwin branch of the Canadian Pacific Railway.

During the past year one hundred and ten thousand acres of Buffalo Park has been inclosed by a fourteen-strand wire fence, seventy-three miles in length, with two cross fences forming inclosures for the buffalo during the breeding season. The new park is a magnificent stretch of rolling prairie and numerous small lakes giving it a park-like appearance, and is in every respect an ideal place for the purpose to which it has been devoted. The large number of buffalo bones and skulls, buffalo wallows, and other evidence of their former occupancy found on it prove it to have been a favourite grazing ground for the herds of buffalo when in the wild state.

Besides the lakes, which furnish abundance of water for the animals, the Battle river passes through the western portion and Ribstone creek through the eastern part of the park. The banks of both streams are well wooded and form an excellent protection for the animals from the heat of summer and the storms of winter. The area inclosed at present is considered sufficient for the support of from five thousand to seven thousand head of buffalo. Hay is found in abundance in the eastern portion of the park and can be put up in stacks at a cost not exceeding from \$2 to \$2.50 per ton. In this item alone there will be a saving of several thousand dollars in favour of Buffalo Park as compared with Elk Island Park. This guarantees the maintenance of the buffalo at the lowest possible cost to the government.

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A fire-guard twenty feet in width has been ploughed around the inclosure, besides two cross fire-guards across the park. These were made with a view to not only protect the park from all danger of fire from without, but eventually to serve a double purpose of a carriage driveway around the park without entailing any extra expense to the department. It is also intended to move about eighty head of the buffalo now in the Rocky Mountains Park to Buffalo Park during the summer, where they will have freer range and better accommodation. Buildings for the accommodation of the caretaker's horses, &c., will be erected at Wainwright and also at the eastern end of the park where the animals will be wintered.

With the removal of the buffalo from Elk Island Park, the shipments yet to come from Montana and the surplus buffalo at Banff, there will be at least seven hundred head of buffalo in the herd before the close of the coming summer.

The cost of caring for the animals will be very small, as only about three men will be required in summer and five in winter.

With the expected annual natural increase of the herd of from one hundred and fifty to two hundred calves from the commencement, instead of the buffalo being an expense to the government they should prove a considerable source of revenue and be more than self-sustaining, as from the very start the surplus male stock can be readily disposed of at good prices.

The park being located near the main line of the Grand Trunk Transcontinental Railway, and near the point from which the branch to Calgary leaves the main line of the Grand Trunk Pacific Railway, thousands of visitors will be attracted to Buffalo Park each year to see the largest herd of buffalo in the world.

#### JASPER PARK.

I have as yet been unable to officially visit the Jasper Park--the latest addition to Canada's magnificent system of national park reserves--containing five thousand four hundred and fifty square miles of as yet almost entirely unexplored territory. I intend, however, to make a trip to this park during the month of August of this year, when I shall be able to report more fully upon it.

The only available recent information in regard to this park is obtained from a report of a trip made in 1908 through this territory by Mrs. Charles Schaffer, of Philadelphia, Pa., a celebrated botanist and traveller, who has been a regular annual visitor to the Canadian national parks for the past seventeen years. Mrs. Schaffer devotes the winter to lecturing on the results of her exploratory trips to remote parts of the Canadian Rockies and Selkirk ranges before scientific and literary associations in the leading cities of the United States. She has done more than any other living person in making known and arousing interest in the floral and other natural attractions of these regions for scientific research.

Mrs. Schaffer's report to me of her trip is as follows:—

‘During the summer of 1908, a party of six, composed of Mr. Stewardson Brown, Botanist of the Academy of National Sciences, Philadelphia; Miss Adams, of New Haven, Connecticut; three guides and myself, left Laggan, Alberta, for an extended trip into the little-known hills lying to the north. Our outfit consisted of twenty-two horses with food sufficient (about two thousand pounds) for a four months' sojourn in a land where game though plenty is quite uncertain.

‘We had two objects in view: Mr. Brown to make a more exhaustive study of the flora of the higher altitudes, Miss Adams and myself to search for a lake whose existence had been reported to us the year before by a Stony Indian.

‘Our one guiding star was a decidedly dim one, a crude map drawn by the Indian, a grown man at the time; his sketch was from his memory when, as a small boy, he visited it with his father on a hunting expedition.

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'The first part of our trail lay for seventy-five miles through the National Park. The date of departure being June 8, we were forced, owing to its lower altitude, to use the Bow Pass, reaching it via Bow river and lakes. Though I have now travelled many hundreds of miles between Laggan and the Yellowhead Pass, this valley, near home, stands pre-eminent as the worst section for muskeg I have known. A partially constructed trail on the hill-side cancels a good deal of the explorer's trouble, but there are several miles still left through which to plough. From the Bow across Nigel Pass, then down a branch of the Brazeau to the outlet of Brazeau lake was an old story; from then on, the ground to be travelled was new. After crossing Pobocton Pass and traversing a goodly portion of the creek of the same name, all other maps than the Indian's ceased to be anything but a blank.

'The scenery, however, continued to be wild and beautiful, growing more interesting as we advanced. One or two valleys were penetrated on foot to see if the lake could be located. Finally, in the beginning of our third week from Laggan, we crossed a short pass of about seven thousand feet elevation and gazed down on one of the fairest grass-covered, flower-strewn valleys I have seen in the Canadian Rocky range.

'After traversing it for three days, our second in command climbed to a height of eight thousand feet and returned about 10.30 p.m. to report that the lake was at the terminus of the green valley.

'The following day we reached the shores of our long-sought goal. Plenty of feed was found for the horses a half mile back from the lake. A raft was soon constructed which carried tents, bedding and food for three days, and those most interested pushed for the head of the lake.

'Later developments proved the stretch of water to be about twenty miles long. At the outlet a fire a few years ago destroyed about one-quarter of a mile of timber, otherwise the slopes from tree line to shore are covered with a dense growth of spruce and pine. This growth is so heavy it is not only impracticable to take horses to the head of the lake, but even should they reach there there seems to be no grass for them.

'We found several fine peaks at the head of the lake, the conditions of the snow and ice proclaiming them between ten thousand and twelve thousand feet high. Glaciers swept down almost to the water's edge and at one place from a ragged rock precipice plunged a ribbon of water. In its thousands of feet fall, it was lost in spray. I think without exception it is one of the most beautiful sections I have ever visited, and the lake is undoubtedly the largest one yet recorded in the Rocky range. The outlet is comparatively a narrow one and looks quite harmless, but experience proved, at least during high water, that no horse could stem the flow with pack or saddle.

'Later investigation proved that this river empties into Medicine lake and from there as Maligne river flows into the Athabaska river, almost opposite to the mouth of the Miette river, which has its source in the Yellowhead Pass. Hence we have called the short pass, the stream flowing from it to the lake, the green valley, the lake itself and one of the peaks Maligne. Being but a matter of thirty to thirty-five miles south of the line of the advancing Grand Trunk Pacific road, it will undoubtedly at some future day become a famous resort for the lover of the beautiful.

'Since writing the above short sketch I have learned that the government has set aside 5,400 square miles (with Jasper House as a centre) of land as a national park. I can but trust that for the sake of the beauty of the lake, its almost unblemished forest and the game, Maligne lake may pass under the care of a government whose foresight and generosity to future lovers of the wild have been equalled by no other nation.

'MRS. CHARLES SCHAFFER.'

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## THE MONTANA HERD OF BUFFALO.

In connection with the balance of the shipment of buffalo purchased in 1907 from Michel Don Pablo, of Missoula, I have to report that owing to unforeseen and uncontrollable circumstances, we were unable to accomplish our purpose of having them transferred to Canadian soil during the year just closed.

Owing to sickness in his family and his own serious illness, Mr. Pablo was unable to commence the round-up of the animals until late in the season. I urged that operations should be started earlier, but it was not until my second visit to Montana in August that a move could be made. After several weeks of strenuous work we succeeded in gathering together in the corral one hundred and twenty of the animals preparatory to driving them thirty-six miles to be loaded on the train at Ravalli. On the night following their being corralled the enraged animals stampeded, climbed the high, almost perpendicular clay cut-bank at the rear of the inclosure and escaped to their native homes among the mountains of the Flathead reservation.

As it was getting late in the season and the early snows were falling in the mountains, which would render the difficulties in the way of again collecting the frightened animals insurmountable, we decided to abandon the attempt until the following spring. We were also induced to take this course, owing to the fact that after their recent exhausting struggle and flight for freedom, the animals were in very poor condition for shipment such a long distance so late in the season.

For the unsuccessful round-up, Mr. Pablo was at several thousands of dollars of expense for supplies, wages of men, &c., besides having a number of his horses disabled, for which he will not receive one cent of remuneration. He, however, acted throughout the whole affair in a perfectly honest and straightforward manner, and faithfully promised that as soon as the snow was off the ground sufficiently to allow of the animals being rounded up he would start his men to work. He is very anxious that his contract for the delivery of the entire herd to the Canadian government shall be carried out with as little delay as possible.

The result of our operations this year has been very disappointing to him and also to myself, as I had confidently expected this year to see the work of landing the buffalo at their future home in Buffalo Park on Canadian soil, reach a successful conclusion. I have every hope, however, that this will be successfully accomplished early in the next fiscal year.

Since the above was written, I am glad to be able to report that the first shipment consisting of one hundred and ninety head, one hundred and seventeen of which were young females, has been successfully landed in Buffalo Park, and the remainder, of about one hundred and twenty head, will be shipped early in the summer.

A new plan for transferring them from the corral to the loading pens was devised. Instead of the animals being driven in a herd they were transported individually in wagons over the thirty-six miles to Ravalli for loading. Experienced spectators of the work expressed their surprise and wonder at the magnitude of the task of rounding-up, transporting in wagons to the loading station and shipping over almost thirteen hundred miles of railway, such a large number of these wild, untamed animals and landing them successfully and safely in their new homes. The undertaking involved a vast amount of work, anxiety and expense, and it is doubtful whether a similar enterprise of rescuing from threatened extermination a once noble and numerous type of animal, was ever before undertaken.

A fuller and more detailed report of the shipments will be made in my next year's report, when I hope to be able to congratulate the government of the Dominion of Canada on having safely secured in its Buffalo Park reserve, the largest herd, not only of buffalo but of any wild animals in one inclosure, in the world.

In conclusion I desire to express my appreciation of the support which I have at all times received from the department in furthering the development of the Canadian

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national parks, and especially in the matter of securing the buffalo which would at times have been so discouraging as to suggest the abandoning of the undertaking entirely had I not been assured of the hearty support and co-operation of the Honourable Minister and every one connected with the department in the work.

I also wish to acknowledge the valuable services rendered by the members of the Royal Northwest Mounted Police in maintaining law and order in the different parts of the national parks where they were stationed.

I have the honour to be, Sir,

Your obedient servant,

HOWARD DOUGLAS,

*Commissioner of Dominion Parks.*

## APPENDICES.

## VISITORS AT HOTELS.

Number of visitors registered at the Banff Springs Hotel from April 1, 1908, to April 1, 1909 :—

|                    |             |
|--------------------|-------------|
| Canada.....        | 2,318       |
| United States..... | 4,082       |
| England.....       | 384         |
| Australia.....     | 62          |
| Scotland.....      | 50          |
| India.....         | 28          |
| Japan.....         | 56          |
| China.....         | 46          |
| France.....        | 24          |
| Honolulu.....      | 18          |
| Ireland.....       | 37          |
| New Zealand.....   | 64          |
| Switzerland.....   | 3           |
| Mexico.....        | 1           |
| Norway.....        | 7           |
| Italy.....         | 5           |
| Holland.....       | 6           |
| Denmark.....       | 4           |
| Chili.....         | 2           |
| Total.....         | <hr/> 7,197 |

Number of visitors registered at the Mount Royal Hotel from April 1, 1908, to April 1, 1909 :—

|                    |       |
|--------------------|-------|
| Canada.....        | 1,240 |
| United States..... | 482   |
| England.....       | 64    |
| Scotland.....      | 22    |
| Ireland.....       | 18    |
| New Zealand.....   | 10    |
| Australia.....     | 6     |
| Italy.....         | 4     |

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|                  |              |
|------------------|--------------|
| China.....       | 4            |
| Germany.....     | 2            |
| Switzerland..... | 2            |
| India.....       | 1            |
| Total.....       | <u>1,955</u> |

Number of visitors registered at the Sanitarium Hotel from April 1, 1908, to April 1, 1909 :—

|                         |              |
|-------------------------|--------------|
| Canada.....             | 6,018        |
| United States.....      | 1,490        |
| England.....            | 152          |
| Scotland.....           | 86           |
| Ireland.....            | 42           |
| Japan.....              | 43           |
| New Zealand.....        | 72           |
| Denmark.....            | 16           |
| Australia.....          | 80           |
| India.....              | 8            |
| China.....              | 26           |
| Holland.....            | 10           |
| Germany.....            | 27           |
| Chili.....              | 14           |
| Italy.....              | 18           |
| Switzerland.....        | 41           |
| Portugal.....           | 16           |
| Korea.....              | 4            |
| France.....             | 14           |
| Austria.....            | 2            |
| Philippine Islands..... | 31           |
| South Africa.....       | 28           |
| Total.....              | <u>8,238</u> |

Number of visitors registered at the Hotel King Edward, from April 1, 1908, to April 1, 1909.

|                    |              |
|--------------------|--------------|
| Canada.....        | 4,284        |
| United States..... | 1,282        |
| England.....       | 94           |
| Scotland.....      | 43           |
| Ireland.....       | 78           |
| Switzerland.....   | 6            |
| New Zealand.....   | 59           |
| Australia.....     | 28           |
| South Africa.....  | 1            |
| Japan.....         | 13           |
| India.....         | 4            |
| Germany.....       | 4            |
| Austria.....       | 4            |
| China.....         | 11           |
| Total.....         | <u>5,911</u> |



## SESSIONAL PAPER No. 25

Number of visitors registered at the Hot Springs Hydropathic Hotel, from April 1, 1908, to April 1, 1909 :—

|                    |              |
|--------------------|--------------|
| Canada.....        | 792          |
| United States..... | 204          |
| England.....       | 22           |
| Scotland.....      | 18           |
| New Zealand.....   | 9            |
| Germany.....       | 6            |
| Australia.....     | 9            |
| Ireland.....       | 11           |
| Japan.....         | 6            |
| Total.....         | <u>1,077</u> |

Number of visitors registered at the Alberta Hotel from April 1, 1908, to April 1, 1909 :—

|                    |              |
|--------------------|--------------|
| Canada.....        | 4,340        |
| United States..... | 1,622        |
| England.....       | 238          |
| Scotland.....      | 209          |
| Ireland.....       | 107          |
| Sweden.....        | 22           |
| New Zealand.....   | 69           |
| Australia.....     | 20           |
| China.....         | 28           |
| India.....         | 2            |
| South Africa.....  | 1            |
| Germany.....       | 6            |
| Total.....         | <u>6,664</u> |

Number of visitors registered at the Grand View Villa, Banff, from April 1, 1908, to April 1, 1909 :—

|                    |              |
|--------------------|--------------|
| Canada.....        | 1,120        |
| United States..... | 322          |
| England.....       | 46           |
| Japan.....         | 2            |
| India.....         | 9            |
| Ireland.....       | 22           |
| China.....         | 10           |
| Scotland.....      | 28           |
| Australia.....     | 13           |
| Switzerland.....   | 1            |
| Ceylon.....        | 3            |
| Holland.....       | 4            |
| New Zealand.....   | 11           |
| France.....        | 3            |
| Total.....         | <u>1,594</u> |

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## SUMMARY.

|                                   |               |
|-----------------------------------|---------------|
| Banff Springs Hotel.....          | 7,197         |
| Mount Royal Hotel.....            | 1,955         |
| Sanitarium.....                   | 8,238         |
| Hotel King Edward.....            | 5,911         |
| Hot Springs Hydropathic.....      | 1,077         |
| Alberta Hotel.....                | 6,664         |
| Grand View Villa.....             | 1,594         |
| Park Hotel.....                   | 1,500         |
| Excursionists not registered..... | 3,684         |
| Cottagers.....                    | 1,960         |
| <b>Total.....</b>                 | <b>39,780</b> |

Number of visitors at the Cave and Basin, from April 1, 1908, to April 1, 1909:—

|                      |              |
|----------------------|--------------|
| Canada.....          | 4,105        |
| United States.....   | 3,302        |
| England.....         | 203          |
| Scotland.....        | 93           |
| Ireland.....         | 7            |
| New Zealand.....     | 49           |
| Australia.....       | 25           |
| New South Wales..... | 7            |
| South Africa.....    | 11           |
| India.....           | 5            |
| Ceylon.....          | 2            |
| China.....           | 11           |
| Japan.....           | 5            |
| France.....          | 7            |
| Germany.....         | 10           |
| Sweden.....          | 8            |
| Holland.....         | 4            |
| <b>Total.....</b>    | <b>7,854</b> |

Number of visitors at the Upper Hot Springs, from April 1, 1908, to April 1, 1909:—

|                               |               |
|-------------------------------|---------------|
| United States and Canada..... | 14,032        |
| Newfoundland.....             | 2             |
| England.....                  | 151           |
| Scotland.....                 | 53            |
| Ireland.....                  | 28            |
| Australia.....                | 46            |
| South Africa.....             | 4             |
| India.....                    | 2             |
| Hawaiian Islands.....         | 2             |
| Germany.....                  | 6             |
| China.....                    | 8             |
| Japan.....                    | 4             |
| Denmark.....                  | 14            |
| Sweden.....                   | 2             |
| <b>Total.....</b>             | <b>14,355</b> |

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Number of visitors registered at the Chalet, Lake Louise, Laggan, from April 1, 1908, to April 1, 1909:—

|                     |              |
|---------------------|--------------|
| Canada.....         | 1,904        |
| United States.....  | 4,028        |
| England.....        | 402          |
| Scotland.....       | 68           |
| Ireland.....        | 14           |
| Japan.....          | 2            |
| Russia.....         | 9            |
| France.....         | 3            |
| Cuba.....           | 5            |
| Australia.....      | 32           |
| India.....          | 9            |
| Holland.....        | 16           |
| China.....          | 4            |
| New Zealand.....    | 38           |
| Honolulu.....       | 9            |
| Denmark.....        | 2            |
| Jamaica.....        | 1            |
| Germany.....        | 43           |
| Poland.....         | 1            |
| South America.....  | 2            |
| Sweden.....         | 9            |
| Switzerland.....    | 12           |
| Africa.....         | 1            |
| Italy.....          | 22           |
| Alaska.....         | 4            |
| Belgium.....        | 6            |
| South Anchohia..... | 1            |
| Hawaii.....         | 9            |
| Total.....          | <u>6,656</u> |

List of visitors at the Mount Stephen House, Field, from April 1, 1908, to April 1, 1909:—

|                    |              |
|--------------------|--------------|
| United States..... | 1,922        |
| Canada.....        | 2,019        |
| British Isles..... | 486          |
| Australia.....     | 64           |
| New Zealand.....   | 96           |
| Germany.....       | 29           |
| India.....         | 6            |
| Japan.....         | 1            |
| China.....         | 14           |
| South America..... | 6            |
| France.....        | 9            |
| Switzerland.....   | 38           |
| Hungary.....       | 6            |
| Hawaii.....        | 9            |
| South Africa.....  | 6            |
| Holland.....       | 14           |
| Italy.....         | 18           |
| Denmark.....       | 2            |
| Jamaica.....       | 1            |
| Sweden.....        | 9            |
| Tasmania.....      | 9            |
| Belgium.....       | 6            |
| Total.....         | <u>3,770</u> |

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## MUSEUM.

## REPORT OF THE CURATOR.

ROCKY MOUNTAINS PARKS OF CANADA,  
BANFF, ALBERTA, July 2, 1909.

HOWARD DOUGLAS, Esq.,  
Commissioner of Dominion Parks,  
Banff, Alberta.

SIR,—As will be seen by the attached list of visitors for the twelve months there has been a decided increase.

*Additions.*—Two young cariboo heads and a few birds collected by myself, as well as a number of birds' eggs have been added to the museum; also a collection of sponges, shells, corals, &c., from the Bahama Islands, and garnets from Alaska was donated by Mr. A. C. Talbot, of Calgary. The former, although not in the collecting grounds, are most interesting. Promises of loans and donations are becoming more numerous but do not always materialize.

*Work done.*—The collection of insects is being rapidly added to, and I have to thank Dr. E. M. Walker, of the Biological Section of Toronto University, for giving much help in naming orthoptera and odonta; Dr. L. O. Howard, the eminent chief of the entomological branch of the Department of Agriculture, Washington, D.C., and his expert assistants for valuable assistance in naming specimens in the orders hymenoptera, diptera, coleoptera, hemiptera, &c.; also the Experimental Farm Entomological Branch for much assistance in naming lepidoptera and other orders.

*Suggested improvements.*—As soon as at all possible the mammals of the park should be completed and represented in the museum by full sized specimens. Many common animals are not yet on exhibition, and to make the best specimens these should be taken in the fall, winter or early spring.

The mineral collection should be made more complete by additional specimens from the neighbourhood, as also from British Columbia and New Ontario.

Some method of displaying the maps received from the Geological Survey Department would be of advantage as they prove most interesting as well as useful and instructive to many of the visitors.

Any addition to the Indian collection would be money well invested, as the day for procuring these things will soon be past. I may say that nearly all the visitors are very much interested in the display of Indian work now on loan. It might be well to purchase the Reverend Canon Stocken's collection, which I understand he is desirous of selling at a reasonable price.

Many useful and interesting pamphlets are now in my possession relative to museum work, &c., which, to be of more use for the purpose of reference, should be placed in a suitable book case and catalogued.

As usual, I have during the past year named many plants for visitors and also given much other information.

I enclose the weather report for the past year.

I am, Sir,

Your obedient servant,

N. B. SANSON.

*Curator.*

## SESSIONAL PAPER No. 25

Visitors at the Museum, from April 1, 1908, to April 1, 1909 :—

|                          |       |
|--------------------------|-------|
| Canada.....              | 6,450 |
| Yukon Territory.....     | 18    |
| Newfoundland.....        | 2     |
| United States.....       | 2,221 |
| England.....             | 432   |
| Scotland.....            | 197   |
| Ireland.....             | 42    |
| South Wales.....         | 3     |
| Wales.....               | 1     |
| Isle of Man.....         | 1     |
| Channel Islands.....     |       |
| Australia.....           | 84    |
| New South Wales.....     | 4     |
| New Zealand.....         | 97    |
| South Africa.....        | 4     |
| Zululand.....            | 1     |
| Orange River Colony..... | 4     |
| Germany.....             | 47    |
| The Hague.....           | 1     |
| Holland.....             | 16    |
| Belgium.....             | 18    |
| China.....               | 24    |
| Thibet.....              | 1     |
| Italy.....               | 7     |
| India.....               | 10    |
| France.....              | 19    |
| Norway.....              | 7     |
| Austria.....             | 22    |
| Japan.....               | 19    |
| Sweden.....              | 12    |
| Russia.....              | 7     |
| South America.....       | 4     |
| Switzerland.....         | 28    |
| Denmark.....             | 14    |
| Total.....               | 9,817 |

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## METEOROLOGICAL TABLES

## ROCKY MOUNTAINS PARK.

MAXIMUM and Minimum Temperatures and the General State of the Weather between July 1, 1908, and June 30, 1909.

| Date.      | THERMOMETER READINGS. |                  | Weather.   |
|------------|-----------------------|------------------|--|
|            | Maximum for day.      | Minimum for day. |  |
| 1908.      | °                     | °                |  |
| July 1.... | 77.1                  | 38.2             | Fair; very fine day.   |
| " 2....    | 78.0                  | 39.7             | Cloudy; thunder; rain.   |
| " 3....    | 67.4                  | 44.0             | Cloudy; squally wind.  |
| " 4....    | 58.7                  | 42.8             | Cloudy; light rain; river high and muddy; lightning.                             |
| " 5....    | 63.9                  | 37.2             | Fair; fine day.  |
| " 6....    | 71.6                  | 36.3             | Fair.  |
| " 7....    | 77.4                  | 40.0             | Fair; very fine day.   |
| " 8....    | 77.4                  | 43.3             | Fair.  |
| " 9....    | 67.5                  | 60.4             | Cloudy; squally wind.  |
| " 10....   | 77.4                  | 48.8             | Fair; perfect day.   |
| " 11....   | 81.7                  | 43.7             | Fair; perfect day; campanula in flower.  |
| " 12....   | 69.6                  | 44.7             | Cloudy; fine day; cirro-stratus and cirrus clouds.                               |
| " 13....   | 68.0                  | 52.8             | Cloudy; rain.  |
| " 14....   | 67.3                  | 52.8             | Cloudy; strawberries abundant.   |
| " 15....   | 75.9                  | 47.2             | Fair; perfect day; river very high.  |
| " 16....   | 71.6                  | 45.2             | Cloudy; light rain; lightning; Shepherdia in fruit.                              |
| " 17....   | 76.1                  | 48.8             | Fair; light rain; asters in flower; thunder and lightning.                       |
| " 18....   | 76.6                  | 42.2             | Fair; fine day.  |
| " 19....   | 78.1                  | 55.0             | Fair.  |
| " 20....   | 84.4                  | 41.0             | Fair; very fine day; many insects.   |
| " 21....   | 87.5                  | 42.3             | Fair; very fine day; forest fire.  |
| " 22....   | 86.5                  | 44.9             | Fair; forest fire; very fine day.  |
| " 23....   | 73.4                  | 50.0             | Cloudy; rain; thunder and lightning; forest fire out.                            |
| " 24....   | 77.5                  | 49.6             | Fair.  |
| " 25....   | 69.2                  | 48.0             | Cloudy; rain; fine sunset.   |
| " 26....   | 65.5                  | 37.6             | Fair; very fine day.   |
| " 27....   | 70.8                  | 33.5             | Fair; forest fire.   |
| " 28....   | 53.8                  | 41.3             | Cloudy; rain; thunder and lightning.   |
| " 29....   | 69.4                  | 35.0             | Fair; very fine day.   |
| " 30....   | 79.0                  | 39.8             | Fair; very fine day.   |
| " 31....   | 84.5                  | 42.9             | Fair; very fine day; smoke from forest fire.                                     |
| Aug. 1.... | 80.2                  | 43.0             | Fair; rain; thunder and lightning.   |
| " 2....    | 68.0                  | 46.0             | Fair; very fine day.   |
| " 3....    | 69.5                  | 50.6             | Cloudy.  |
| " 4....    | 78.4                  | 44.0             | Fair; fine sunset; forest fire still burning.                                    |
| " 5....    | 81.2                  | 46.3             | Fair; very fine day; large cumulus clouds over fire, &c.; rivers, &c., dropping. |
| " 6....    | 78.4                  | 44.8             | Fair; brilliant meteor, noise in bursting; very fine day, but dense smoke.       |
| " 7....    | 76.2                  | 43.3             | Fair; light rain.  |
| " 8....    | 81.1                  | 36.2             | Fair; very fine day; fire bad in afternoon.                                      |
| " 9....    | 79.4                  | 40.0             | Fair; smoke from forest fire about.  |
| " 10....   | 68.4                  | 43.9             | Fair.  |
| " 11....   | 51.2                  | 43.9             | Cloudy; rain; forest fire nearly out.  |
| " 12....   | 64.2                  | 39.9             | Fair; light rain; forest fire up again.  |
| " 13....   | 66.5                  | 33.1             | Fair; fine day.  |
| " 14....   | 76.1                  | 32.2             | Fair; aurora; very fine day.   |
| " 15....   | 76.4                  | 44.8             | Fair; fine day.  |
| " 16....   | 70.0                  | 47.1             | Fair.  |
| " 17....   | 82.0                  | 36.0             | Fair; very fine day.   |

## SESSIONAL PAPER No. 25

MAXIMUM and Minimum Temperatures, &c.— *Continued.*

| Date.       | THERMOMETER READINGS. |                  | Weather.   |
|-------------|-----------------------|------------------|--|
|             | Maximum for day.      | Minimum for day. |  |
| 1908.       |                       |                  |  |
| Aug. 18.... | 77.0                  | 41.0             | Fair; very fine aurora; very fine day.                                     |
| " 19....    | 84.7                  | 42.0             | Fair; very fine day.   |
| " 20....    | 73.4                  | 43.5             | Fair; thunder; much smoke from fire.                                       |
| " 21....    | 71.4                  | 43.5             | Fair; very fine day.   |
| " 22....    | 77.4                  | 37.5             | Fair; very fine day.   |
| " 23....    | 66.5                  | 38.6             | Cloudy; rain; thunder and lightning; forest fire out.                      |
| " 24....    | 62.0                  | 45.6             | Cloudy.  |
| " 25....    | 47.1                  | 37.8             | Cloudy; rain.  |
| " 26....    | 54.1                  | 38.7             | Cloudy; fine sunset.   |
| " 27....    | 62.4                  | 32.2             | Fair; light rain.  |
| " 28....    | 59.3                  | 42.1             | Fair.  |
| " 29....    | 58.3                  | 49.3             | Cloudy.  |
| " 30....    | 55.8                  | 36.0             | Cloudy; rain; very fine rainbow.   |
| " 31....    | 62.2                  | 35.4             | Fair.  |
| Sept. 1.... | 66.9                  | 38.2             | Fair.  |
| " 2....     | 62.0                  | 50.2             | Cloudy; rain.  |
| " 3....     | 63.4                  | 45.7             | Fair.  |
| " 4....     | 69.3                  | 45.8             | Fair; fine sunrise; very fine day.   |
| " 5....     | 73.2                  | 46.2             | Fair; aurora; very fine day.   |
| " 6....     | 76.7                  | 40.2             | Fair; very fine day.   |
| " 7....     | 62.9                  | 46.6             | Cloudy; rain; heavy thunder and vivid lightning.                           |
| " 8....     | 53.1                  | 38.3             | Cloudy; light rain.  |
| " 9....     | 53.0                  | 40.3             | Cloudy; very squally chinook kind of wind.                                 |
| " 10....    | 67.4                  | 49.4             | Fair; very fine day.   |
| " 11....    | 73.4                  | 36.0             | Fair; very fine day.   |
| " 12....    | 75.4                  | 34.7             | Fair; very fine day; brilliant aurora.                                     |
| " 13....    | 75.1                  | 37.9             | Fair; very fine day and night; sheet lightning.                            |
| " 14....    | 70.0                  | 44.0             | Fair; light rain; fine sunrise.  |
| " 15....    | 55.8                  | 40.7             | Cloudy; rain.  |
| " 16....    | 48.8                  | 42.6             | Cloudy; rain.  |
| " 17....    | 62.5                  | 39.9             | Fair; few butterflies still about; very fine afternoon.                    |
| " 18....    | 54.3                  | 35.9             | Cloudy; heavy dewfall.   |
| " 19....    | 61.5                  | 44.0             | Fair; heavy dewfall.   |
| " 20....    | 65.4                  | 53.3             | Fair; very fine day and night.   |
| " 21....    | 64.2                  | 45.7             | Fair; fine sunrise; squally wind.  |
| " 22....    | 50.7                  | 37.3             | Fair; fine day; squally wind.  |
| " 23....    | 42.8                  | 27.3             | Cloudy; rain and snow; geese flying over town.                             |
| " 24....    | 32.3                  | 27.0             | Cloudy; light snow; snow on mountains.                                     |
| " 25....    | 40.3                  | 18.0             | Fair; cool but fine day.   |
| " 26....    | 41.4                  | 18.0             | Cloudy; fine sunrise.  |
| " 27....    | 54.0                  | 33.9             | Cloudy.  |
| " 28....    | 55.4                  | 29.8             | Cloudy.  |
| " 29....    | 58.4                  | 38.5             | Cloudy; squally chinook kind of wind; ducks flying east; fine sunset.      |
| " 30....    | 64.6                  | 29.8             | Fair; very fine day; fine sunrise and sunset; vanessa antiopa butterflies. |
| Oct. 1....  | 53.9                  | 38.2             | Cloudy; heavy rain; fine sunrise.  |
| " 2....     | 38.0                  | 34.3             | Cloudy.  |
| " 3....     | 53.3                  | 26.9             | Fair; very fine day; aurora; few insects about.                            |
| " 4....     | 57.4                  | 24.0             | Fair; light rain; few moths and other insects.                             |
| " 5....     | 50.4                  | 38.8             | Cloudy.  |
| " 6....     | 52.9                  | 29.0             | Fair; fine day.  |
| " 7....     | 60.2                  | 33.9             | Fair; very fine day.   |
| " 8....     | 64.6                  | 33.1             | Fair; very fine day and night.   |
| " 9....     | 49.3                  | 36.6             | Cloudy; trees becoming leafless  |
| " 10....    | 61.0                  | 35.2             | Fair; very fine day.   |
| " 11....    | 59.4                  | 25.3             | Fair; very fine day.   |
| " 12....    | 59.0                  | 26.8             | Cloudy; fine day.  |
| " 13....    | 47.3                  | 37.9             | Cloudy; rain.  |
| " 14....    | 36.2                  | 32.0             | Cloudy; snow; patches of snow on ground.                                   |
| " 15....    | 39.3                  | 23.6             | Cloudy; patches of snow on ground.   |
| " 16....    | 37.6                  | 24.6             | Cloudy.  |
| " 17....    | 39.1                  | 18.2             | Fair.  |
| " 18....    | 40.9                  | 24.2             | Cloudy; fine sunrise; few birds still about.                               |

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## MAXIMUM and Minimum Temperatures, &amp;c.—Continued.

| Date.      | THERMOMETER READINGS. |                  | WEATHER.   |
|------------|-----------------------|------------------|--|
|            | Maximum for day.      | Minimum for day. |  |
| 1908.      | °                     | °                |  |
| Oct. 19... | 31.7                  | 30.1             | Cloudy; snow; about 5.25 in. of snow on ground; few sleighs out; grosbeaks.  |
| " 20....   | 34.1                  | 25.9             | Cloudy; longspurs on way south.  |
| " 21....   | 34.2                  | 21.7             | Fair; fine day.  |
| " 22....   | 34.1                  | 14.9             | Cloudy.  |
| " 23....   | 41.9                  | 17.4             | Fair; skating on ponds; no sleighing.  |
| " 24....   | 42.9                  | 31.7             | Fair.  |
| " 25....   | 44.7                  | 22.3             | Fair; fine sunrise; fine day; redpolls.                                      |
| " 26....   | 52.2                  | 27.2             | Fair; chinooking.  |
| " 27....   | 30.3                  | 24.9             | Cloudy.  |
| " 28....   | 14.3                  | 9.8              | Cloudy; snow; very stormy all day; sleighing but bad; duck flying south.     |
| " 29....   | 21.1                  | 6.5              | Cloudy; Bow river frozen over in places; sleighing but bad.                  |
| " 30....   | 46.3                  | 16.0             | Cloudy; no sleighing.  |
| " 31....   | 43.3                  | 35.8             | Fair; aurora; fine day.  |
| Nov. 1.... | 48.2                  | 24.7             | Fair.  |
| " 2....    | 49.1                  | 38.2             | Fair; rain.  |
| " 3....    | 55.1                  | 42.7             | Cloudy; very light rain; very squally; dry warm wind.                        |
| " 4....    | 58.4                  | 49.7             | Fair; very squally wind; fine warm day.                                      |
| " 5....    | 54.2                  | 46.8             | Fair; squally wind all day and night; fine and warm.                         |
| " 6....    | 51.2                  | 41.7             | Fair; very squally wind; fine and warm.                                      |
| " 7....    | 49.7                  | 41.3             | Fair; squally wind; fine and warm day; aurora.                               |
| " 8....    | 34.3                  | 20.8             | Fair; very fine day.   |
| " 9....    | 28.8                  | 17.7             | Fair.  |
| " 10....   | 21.5                  | 7.6              | Fair; heavy hoar frost; river frozen over above boat house.                  |
| " 11....   | 20.0                  | -1.7             | Fair; river frozen over; about 5 inches thick.                               |
| " 12....   | 20.0                  | -3.4             | Fair.  |
| " 13....   | 32.4                  | 10.1             | Fair.  |
| " 14....   | 31.2                  | 7.0              | Fair.  |
| " 15....   | 33.8                  | 13.1             | Fair; very squally wind late afternoon and through midnight.                 |
| " 16....   | 39.2                  | 26.2             | Cloudy; very light rain; thaw; very squally wind; river ice becoming unsafe. |
| " 17....   | 39.9                  | 32.7             | Cloudy; rain; large flock snowbirds.   |
| " 18....   | 43.6                  | 33.5             | Cloudy; light rain and snow; very squally wind; river open in places.        |
| " 19....   | 42.4                  | 32.7             | Cloudy; squally wind.  |
| " 20....   | 42.0                  | 34.3             | Cloudy; rain with snow at night.   |
| " 21....   | 36.4                  | 31.4             | Cloudy; brilliant meteor.  |
| " 22....   | 36.3                  | 28.7             | Fair.  |
| " 23....   | 34.2                  | 23.8             | Cloudy; fine sunset.   |
| " 24....   | 32.3                  | 23.3             | Cloudy.  |
| " 25....   | 28.6                  | 21.2             | Cloudy.  |
| " 26....   | 26.0                  | 12.8             | Fair; fine day.  |
| " 27....   | 28.2                  | 13.8             | Fair; Bow river partly frozen over.  |
| " 28....   | 34.8                  | 25.0             | Cloudy; fine sunrise; squally wind.  |
| " 29....   | 31.2                  | 7.0              | Cloudy; light snow.  |
| " 30....   | 5.2                   | -7.8             | Fair; Bow river all frozen over; good skating.                               |
| Dec. 1.... | 8.3                   | -14.0            | Fair; heavy hoar frost; only about ¼ inch snow on ground.                    |
| " 2....    | 15.0                  | -1.1             | Fair; fine sunset; squally wind.   |
| " 3....    | 17.3                  | 0.3              | Fair; fine sunset; very fine day.  |
| " 4....    | 25.0                  | 7.8              | Cloudy; mostly patches of snow on ground.                                    |
| " 5....    | 30.7                  | 18.9             | Cloudy; fine sunset.   |
| " 6....    | 25.8                  | 9.3              | Fair; very fine day.   |
| " 7....    | 27.2                  | 15.5             | Fair.  |
| " 8....    | 27.2                  | 8.7              | Cloudy.  |
| " 9....    | 30.3                  | 24.0             | Fair; light snow.  |
| " 10....   | 24.0                  | 2.0              | Fair; fine day.  |
| " 11....   | 30.6                  | 18.7             | Cloudy; very squally wind; light snow.                                       |
| " 12....   | 34.3                  | 25.8             | Cloudy; squally wind; snow.  |
| " 13....   | 31.2                  | 26.6             | Cloudy; squally wind; about 6 inches snow on ground; sleighing but bad.      |
| " 14....   | 25.2                  | 15.0             | Fair; fine day.  |
| " 15....   | 20.0                  | 2.9              | Fair; fine day.  |
| " 16....   | 10.1                  | -9.2             | Fair; fine day.  |



## SESSIONAL PAPER No. 25

## MAXIMUM and Minimum Temperatures, &amp;c.—Continued.

| Date.       | THERMOMETER READINGS. |                  | WEATHER.   |
|-------------|-----------------------|------------------|--|
|             | Maximum for day.      | Minimum for day. |  |
| 1908.       | o                     | o                |  |
| Dec. 17.... | 20·8                  | -12·0            | Fair; fine day; very fine sunrise and sunset.                                |
| " 18....    | 23·2                  | 11·7             | Fair; squally cold wind; very fine sunset; waxwings and grosbeaks.           |
| " 19....    | 25·0                  | 11·1             | Cloudy; very squally wind.   |
| " 20....    | 19·3                  | 11·8             | Fair; squally wind.  |
| " 21....    | 21·2                  | 8·3              | Fair; very fine sunrise and sunset; squally wind.                            |
| " 22....    | 22·2                  | 8·7              | Cloudy.  |
| " 23....    | 26·8                  | 12·7             | Fair.  |
| " 24....    | 25·0                  | 19·4             | Cloudy; squally wind; fine sunrise.  |
| " 25....    | 32·0                  | 19·7             | Cloudy; snow; about 13 inches snow on ground.                                |
| " 26....    | 28·3                  | 21·2             | Cloudy; sleighing good.  |
| " 27....    | 31·0                  | 24·2             | Cloudy.  |
| " 28....    | 33·1                  | 23·6             | Cloudy; snow.  |
| " 29....    | 13·3                  | -0·8             | Fair; fine day; loud reports of frost through midnight; mostly calm all day. |
| " 30....    | -11·4                 | -27·6            | Fair; Lake Minnewanka frozen over; calm all day.                             |
| " 31....    | --8·8                 | -33·8            | Fair; mostly calm all day.   |
| 1909.       |                       |                  |  |
| Jan. 1....  | 12·1                  | -16·8            | Fair; very squally wind; snow drifting.                                      |
| " 2....     | 17·2                  | 8·0              | Cloudy; snow; squally wind; snow drifting.                                   |
| " 3....     | 1·9                   | -10·2            | Cloudy; heavy snow; very gusty wind; snow drifting much.                     |
| " 4....     | -16·6                 | -20·4            | Cloudy; squally wind; about 20 inches of snow on ground.                     |
| " 5....     | -18·6                 | -46·0            | Fair; fine sunset; mist from river obscuring near objects                    |
| " 6....     | -15·6                 | -27·8            | Cloudy; squally cold wind.   |
| " 7....     | -30·0                 | -45·0            | Fair; mostly calm all day; light snow; much mist rising from river.          |
| " 8....     | -25·0                 | -47·0            | Fair; mountains veiled in mist 5 p. m.                                       |
| " 9....     | -21·2                 | -35·9            | Fair; parhelia.  |
| " 10....    | -22·4                 | -44·9            | Fair; very bright clear day and calm.  |
| " 11....    | -6·0                  | -29·8            | Fair.  |
| " 12....    | -4·0                  | -12·9            | Cloudy; squally wind.  |
| " 13....    | -10·7                 | -24·2            | Cloudy; squally wind.  |
| " 14....    | -12·4                 | -26·7            | Fair; mostly calm all day.   |
| " 15....    | 18·0                  | -1·5             | Cloudy; snow; squally wind.  |
| " 16....    | 34·2                  | 24·8             | Cloudy; squally wind; ice on river about 19 inches.                          |
| " 17....    | 31·0                  | 22·7             | Cloudy; snow.  |
| " 18....    | 29·8                  | 24·7             | Cloudy; light snow.  |
| " 19....    | 30·0                  | 21·3             | Cloudy; snow; snow changing to rain about 10 p.m.                            |
| " 20....    | 31·1                  | 23·7             | Fair.  |
| " 21....    | 28·1                  | 14·3             | Cloudy; snow.  |
| " 22....    | 23·7                  | 2·6              | Cloudy; snow; about 20 inches of snow on ground.                             |
| " 23....    | 19·9                  | -8·2             | Cloudy; snow-flurries.   |
| " 24....    | 23·9                  | 9·4              | Cloudy.  |
| " 25....    | 27·0                  | 13·2             | Cloudy; light snow; ice cutting on Bow river.                                |
| " 26....    | 28·3                  | 21·0             | Cloudy; chinooking; ice on Bow river 26 inches.                              |
| " 27....    | 33·2                  | 17·6             | Cloudy; snow; a gale.  |
| " 28....    | 9·3                   | -13·4            | Fair; about 22 inches of snow on ground.                                     |
| " 29....    | 14·9                  | -21·4            | Fair; loud reports from frost early morning; squally wind.                   |
| " 30....    | 26·7                  | 8·0              | Fair; squally wind; fine mild day.   |
| " 31....    | 33·0                  | 19·4             | Cloudy.  |
| Feb. 1....  | 36·2                  | 20·8             | Cloudy; light rain and snow; thaw.   |
| " 2....     | 38·7                  | 25·8             | Cloudy.  |
| " 3....     | 39·0                  | 32·3             | Cloudy; thaw; very light rain; very heavy snow-storm 10 p.m.                 |
| " 4....     | 28·3                  | 14·3             | Cloudy; light snow.  |
| " 5....     | 26·3                  | 7·3              | Fair.  |
| " 6....     | 8·4                   | -0·8             | Cloudy; squally wind; snow drifting.   |
| " 7....     | -9·8                  | -14·5            | Cloudy; very squally, cold wind; light snow; loud reports frost upheaving.   |
| " 8....     | 0·3                   | -32·1            | Fair; fine sunset.   |
| " 9....     | 21·4                  | -14·3            | Fair; fine day.  |
| " 10....    | 7·0                   | -6·9             | Cloudy; light snow; very squally wind afternoon and through midnight.        |
| " 11....    | -14·8                 | -20·2            | Cloudy; snow; very squally wind; stormy.                                     |
| " 12....    | -4·9                  | -33·7            | Fair; calm all day; comparatively warm in sun.                               |

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## MAXIMUM and Minimum Temperatures, &amp;c.—Continued.

| Date.       | THERMOMETER READINGS. |                  | Weather.   |
|-------------|-----------------------|------------------|--|
|             | Maximum for day.      | Minimum for day. |  |
| 1909.       |                       |                  |  |
| Feb. 13.... | - 3.3                 | -38.0            | Fair; mostly calm; fine sunset.                            |
| " 14....    | 19.3                  | -25.3            | Cloudy; squally wind.                                      |
| " 15....    | 29.0                  | 16.3             | Cloudy; snow flurries.                                     |
| " 16....    | 34.1                  | 23.1             | Cloudy; light snow.  |
| " 17....    | 37.3                  | 28.2             | Cloudy; fine sunset; squally wind.                         |
| " 18....    | 37.3                  | 26.8             | Cloudy; ice on Bow river 2½ inches thick.                  |
| " 19....    | 32.2                  | 20.6             | Cloudy.  |
| " 20....    | 29.8                  | 9.8              | Fair; ice on Lake Minnewanka 23 inches; fine sunrise.      |
| " 21....    | 29.1                  | - 5.3            | Fair; very fine day; mostly calm all day.                  |
| " 22....    | 25.0                  | 5.8              | Fair; snow in woods about 23 inches deep.                  |
| " 23....    | -28.7                 | 9.5              | Cloudy; squally wind.                                      |
| " 24....    | 35.5                  | 22.1             | Cloudy; thaw; light snow evening.                          |
| " 25....    | 38.0                  | 28.0             | Fair; thaw.  |
| " 26....    | 34.2                  | 27.3             | Cloudy; squally wind.                                      |
| " 27....    | 34.3                  | 24.3             | Cloudy.  |
| " 28....    | 30.1                  | 18.9             | Cloudy; light snow.  |
| Mar. 1....  | 32.4                  | 14.0             | Cloudy.  |
| " 2....     | 32.2                  | 24.6             | Fair; very squally wind.                                   |
| " 3....     | 43.7                  | 17.9             | Fair; thaw.  |
| " 4....     | 41.2                  | 24.6             | Cloudy; light snow; fine sunset.                           |
| " 5....     | 30.4                  | 11.2             | Fair.  |
| " 6....     | 31.4                  | - 5.9            | Fair; very fine day; mostly calm all day.                  |
| " 7....     | 32.0                  | - 4.0            | Fair.  |
| " 8....     | 34.8                  | 18.5             | Fair; snow.  |
| " 9....     | 33.2                  | 10.3             | Fair; light snow.  |
| " 10....    | 26.2                  | - 4.9            | Fair; mostly calm day.                                     |
| " 11....    | 37.2                  | 11.2             | Cloudy.  |
| " 12....    | 29.6                  | 24.0             | Cloudy; snow.  |
| " 13....    | 44.0                  | 12.3             | Fair; thaw; 20 inches of snow on ground.                   |
| " 14....    | 41.0                  | 30.2             | Cloudy; mostly calm all day; thaw.                         |
| " 15....    | 46.0                  | 13.8             | Fair; fine day; fine sunset; thaw.                         |
| " 16....    | 47.2                  | 20.0             | Fair; thaw.  |
| " 17....    | 34.2                  | 27.8             | Cloudy; light snow; small flies appearing.                 |
| " 18....    | 34.8                  | 13.0             | Fair.  |
| " 19....    | 37.0                  | 21.7             | Cloudy; red winged blackbird; crow.                        |
| " 20....    | 32.7                  | 12.3             | Fair; light snow; mostly calm all day; aurora.             |
| " 21....    | 33.2                  | 11.2             | Cloudy; sleighing becoming bad; some wheels in use.        |
| " 22....    | 36.9                  | 7.3              | Cloudy; aurora; fine sunset.                               |
| " 23....    | 45.8                  | 10.8             | Fair; very fine day; sleighing bad; thaw.                  |
| " 24....    | 47.0                  | 16.4             | Fair; very fine day; thaw.                                 |
| " 25....    | 42.2                  | 32.3             | Fair; very gusty wind; chinooking; robin.                  |
| " 26....    | 38.6                  | 16.6             | Cloudy.  |
| " 27....    | 42.2                  | 26.8             | Cloudy; mostly calm all day; light rain and snow.          |
| " 28....    | 29.0                  | 19.0             | Cloudy.  |
| " 29....    | 39.2                  | 8.4              | Fair.  |
| " 30....    | 44.3                  | 26.1             | Fair.  |
| " 31....    | 45.2                  | 35.4             | Cloudy; Bow river open in places.                          |
| April 1.... | 36.3                  | 18.3             | Cloudy; light snow.  |
| " 2....     | 35.2                  | 15.7             | Fair; snow flurries; fine sunrise.                         |
| " 3....     | 33.8                  | 12.2             | Fair; snow flurries; aurora.                               |
| " 4....     | 33.0                  | 6.6              | Fair; very fine sunrise; mountain bluebirds.               |
| " 5....     | 34.8                  | 15.9             | Cloudy; light snow; juncos.                                |
| " 6....     | 33.2                  | 9.3              | Fair; thaw.  |
| " 7....     | 42.6                  | 5.9              | Fair; fine day; sleighing on sheltered roads; fine sunset. |
| " 8....     | 47.3                  | 21.3             | Fair; fine sunrise.  |
| " 9....     | 48.3                  | 30.2             | Cloudy; light snow; river rising.                          |
| " 10....    | 38.2                  | 28.1             | Fair.  |
| " 11....    | 35.6                  | 18.5             | Cloudy; wild geese about.                                  |
| " 12....    | 30.4                  | 14.8             | Cloudy; Bow river mostly open; light snow.                 |
| " 13....    | 33.6                  | 19.8             | Cloudy; snow flurries; golden-eye duck.                    |
| " 14....    | 36.3                  | 12.9             | Cloudy; snow.  |
| " 15....    | 39.1                  | 25.4             | Cloudy; snow; thaw.  |
| " 16....    | 33.0                  | 25.2             | Cloudy; light snow; no sleighing                           |
| " 17....    | 36.3                  | 13.0             | Fair; fine day but cold wind; hawks.                       |

## SESSIONAL PAPER No. 25

## MAXIMUM and Minimum Temperatures, &amp;c.—Continued.

| Date.        | THERMOMETER READINGS. |                  | Weather.  |
|--------------|-----------------------|------------------|---|
|              | Maximum for day.      | Minimum for day. |   |
| 1909.        | °                     | °                |   |
| April 18.... | 43·6                  | 11·8             | Fair; Bow river open.   |
| " 19....     | 41·0                  | 14·9             | Cloudy; light snow.   |
| " 20....     | 33·0                  | 19·0             | Cloudy; anemone, patens variety, in flower; snow flurries.  |
| " 21....     | 42·3                  | 18·8             | Cloudy; junco.  |
| " 22....     | 44·2                  | 18·6             | Cloudy; snow flurries; robins numerous.   |
| " 23....     | 41·3                  | 21·2             | Cloudy.   |
| " 24....     | 55·2                  | 33·8             | Cloudy.   |
| " 25....     | 45·1                  | 34·0             | Cloudy; light snow; sharpshinned hawks.   |
| " 26....     | 42·2                  | 22·9             | Cloudy.   |
| " 27....     | 39·0                  | 25·9             | Cloudy; light snow.   |
| " 28....     | 27·4                  | 24·8             | Cloudy; light snow; gusty wind morning; horned larks.   |
| " 29....     | 33·9                  | 13·9             | Fair; snow mostly in patches.   |
| " 30....     | 41·3                  | 13·0             | Cloudy; grebe.  |
| May 1....    | 52·8                  | 28·7             | Fair; fine afternoon; thaw; petasites partly in flower.   |
| " 2....      | 61·5                  | 29·3             | Cloudy; very fine and warm wind; ants out; vanessa milberti.  |
| " 3....      | 64·5                  | 32·5             | Cloudy; very fine and warm wind; strong wind; frogs piping.   |
| " 4....      | 52·3                  | 35·1             | Cloudy; rain; squally wind; belted kingfisher; catkins on aspen poplars.  |
| " 5....      | 41·1                  | 21·9             | Cloudy; squally wind.   |
| " 6....      | 43·0                  | 30·7             | Cloudy; gull.   |
| " 7....      | 49·3                  | 26·4             | Fair; fine day.   |
| " 8....      | 52·1                  | 21·8             | Fair; American merganser; swallow.  |
| " 9....      | 57·3                  | 22·9             | Fair; ruby crowned kinglet; yellow throat warbler; Brewer's blackbird.  |
| " 10....     | 54·4                  | 34·9             | Cloudy; light rain; white crowned sparrows; chipping sparrows; osprey, nuthatch, sparrow hawk, grouse drumming; grass green; anemones plentiful; shepherdia Canadensis in flower; swallows, bees, water insects, midges, mosquitoes, ground bees; vanessa antiopa; Audubon's warbler. |
| " 11....     | 39·1                  | 33·7             | Cloudy; light rain and snow.  |
| " 12....     | 59·2                  | 29·9             | Fair; fine day.   |
| " 13....     | 42·2                  | 32·2             | Cloudy; snow and light rain; bright aurora.   |
| " 14....     | 52·4                  | 23·3             | Fair; heavy hoar frost.   |
| " 15....     | 39·1                  | 30·8             | Cloudy; snow; Swainson's leucosticte.   |
| " 16....     | 36·2                  | 28·2             | Cloudy; squally wind; yellow throat warbler.  |
| " 17....     | 42·2                  | 28·1             | Cloudy; light rain and snow; song sparrow.  |
| " 18....     | 53·9                  | 30·8             | Cloudy; mostly calm all day; aurora.  |
| " 19....     | 57·8                  | 26·0             | Fair; aurora.   |
| " 20....     | 52·7                  | 31·5             | Cloudy; light rain; mostly calm.  |
| " 21....     | 48·1                  | 30·4             | Cloudy; rain; olive backed thrush; Calypso borealis.  |
| " 22....     | 48·2                  | 37·9             | Cloudy; Arctostaphylos Uva-Ursi in flower.  |
| " 23....     | 52·1                  | 37·8             | Cloudy; rain; primula mistassinica in flower.   |
| " 24....     | 63·5                  | 38·7             | Cloudy; light rain; aurora; lycæna butterfly.   |
| " 25....     | 63·5                  | 37·0             | Fair; rain; thlaspi Orvense in flower; river rising.  |
| " 26....     | 59·6                  | 34·6             | Cloudy; river rising; robins building; fly catchers.  |
| " 27....     | 57·9                  | 35·3             | Cloudy; rain; fine afternoon.   |
| " 28....     | 61·8                  | 39·9             | Cloudy; anemone parviflora; dodocatheon meadia; viola fragaria glauca in flower; adumæa.  |
| " 29....     | 56·4                  | 38·9             | Cloudy; light rain.   |
| " 30....     | 61·0                  | 37·2             | Fair; very squally wind.  |
| " 31....     | 67·1                  | 48·9             | Cloudy; viola Canadensis; aspens in young leaf.   |
| June 1....   | 75·5                  | 34·9             | Fair; thunder; thaspium cordata.  |
| " 2....      | 62·8                  | 47·2             | Fair; rain; Bow river very muddy and high.  |
| " 3....      | 60·4                  | 38·9             | Fair; astragalus alpina.  |
| " 4....      | 55·7                  | 38·7             | Cloudy; rain; commandra livida.   |
| " 5....      | 47·0                  | 36·8             | Cloudy; rain; chickweeds in flower.   |
| " 6....      | 51·1                  | 36·4             | Cloudy; light rain.   |
| " 7....      | 57·0                  | 32·9             | Cloudy; Lake Minnewanka open.   |
| " 8....      | 66·5                  | 28·9             | Fair; wasps; cow birds; corralhoriza innata.  |
| " 9....      | 71·0                  | 31·1             | Fair; heavy dewfall; very fine day and night.   |
| " 10....     | 75·1                  | 34·8             | Fair; very fine day and night; several plants out.  |
| " 11....     | 75·5                  | 34·5             | Fair; very fine day and night.  |
| " 12....     | 71·8                  | 36·9             | Fair; light rain.   |
| " 13....     | 61·4                  | 43·3             | Cloudy; rain.   |

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MAXIMUM and Minimum Temperatures, &c.—*Continued.*

| Date.       | THERMOMETER READINGS. |                     | Weather.   |
|-------------|-----------------------|---------------------|--|
|             | Maximum<br>for day.   | Minimum<br>for day. |  |
| 1909.       |                       |                     |  |
| June 14.... | 72.9                  | 32.7                | Fair; heavy dewfall; very fine day.                            |
| " 15....    | 76.3                  | 38.4                | Fair; lycena butterflies numerous; aspen poplars in good leaf. |
| " 16....    | 69.0                  | 48.9                | Cloudy; light rain; fine day; clematis.                        |
| " 17....    | 66.9                  | 43.5                | Cloudy; wood anemones out.                                     |
| " 18....    | 70.0                  | 48.3                | Fair; fine day.  |
| " 19....    | 69.1                  | 40.2                | Fair; yellow columbine; fine sunset.                           |
| " 20....    | 63.2                  | 46.8                | Cloudy; rain.  |
| " 21....    | 65.9                  | 38.2                | Cloudy; rain.  |
| " 22....    | 62.4                  | 40.2                | Cloudy.  |
| " 23....    | 60.4                  | 43.8                | Cloudy.  |
| " 24....    | 54.1                  | 41.0                | Cloudy; rain.  |
| " 25....    | 59.2                  | 33.9                | Cloudy; rain.  |
| " 26....    | 61.4                  | 31.7                | Cloudy; river about clear again.                               |
| " 27....    | 66.3                  | 40.9                | Fair; fine day.  |
| " 28....    | 66.0                  | 35.2                | Fair; fine day.  |
| " 29....    | 66.2                  | 38.8                | Cloudy; rain; thunder.   |
| " 30....    | 79.4                  | 47.4                | Fair; very fine day and night; many beetles.                   |

N. B. SANSON,  
*Meteorological Agent.*

PART VI  
YUKON TERRITORY



# YUKON TERRITORY

## REPORT OF THE COMMISSIONER.

COMMISSIONER'S OFFICE,

DAWSON, Y.T., April 23, 1909.

The Honourable FRANK OLIVER,  
Minister of the Interior,  
Ottawa.

SIR,—I have the honour to submit the report of the Yukon Territory for the fiscal year ending March 31, 1909.

### GOLD PRODUCTION.

The gold production for the year ending March 31, 1909, shows a considerable increase over that of last year, ending March 31, 1908. According to the returns in the Comptroller's office, the number of ounces produced was 217,350.92, which, at the valuation of \$15 per ounce for royalty purposes, amounts to \$3,260,263.75, or an increase of \$440,000 over last year's output. It is considered that there will now be a steady increase in the annual gold production of the Territory.

### HYDRAULIC MINING AND DREDGING.

The completion of the water system by the Yukon Gold Company will enable it to begin hydraulic operations on a large scale during the present year. This company will also operate seven dredges—four on Bonanza and three on Hunker—and three hydraulic elevators. All the other dredges already installed will be in full operation as soon as the season opens, and probably other new dredges will be placed on the Stewart river during the early part of the season. Attention is called to the exhaustive report of Mr. A. J. Beaudette, the mining engineer, herewith attached, which contains much valuable and carefully collected information.

### INDIVIDUAL MINING.

Considerable work has been carried on by individual miners at Granville, Quartz and Blackhills, in what is known as the Klondike district, and numbers are also working on Glacier and other creeks in the Fortymile district with considerable success.

### QUARTZ.

Prospecting has been carried on all winter, particularly at the head of Dominion creek, where considerable work has been done by a local company. The rock found carries good values, and the parties concerned are most encouraged. They intend proceeding with the work most vigorously during the summer months. Other miners are arranging for the installation of a stamp mill at the head of Victoria gulch, a tributary of Bonanza creek, where splendid specimens of gold-bearing quartz have been found. It is considered that the time is not far distant when the numerous quartz propositions will add materially to the development of the Territory. At Conrad, in the southern end of the Territory, a concentrator has been erected and is now in full operation. The development of quartz on a large scale in any new country always

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takes considerable time, but it is confidently expected that the day is not far distant when the stamp mill will be at work in many parts of the Territory. The report of Mr. R. C. Miller, Assistant Gold Commissioner, gives important details concerning the mining industry in the southern portion of the Territory.

#### AGRICULTURE.

The development of this industry during the past few years has been most remarkable. Constant cultivation seems to increase the fertility of the soil. A few years ago all vegetables consumed in the Yukon were imported, but now potatoes, carrots, turnips, celery, cabbage, cauliflower, besides radishes and lettuce in abundance, are locally grown. In many cases the Yukon vegetables are decidedly superior to those imported. Oats are also grown but usually cut green for fodder. Native hay is used in outside districts, and butter-making has been successfully attempted but not as yet upon a large scale. In a recent report of the president of the White Pass and Yukon Route, a falling off of the traffic for last year is attributed, to a certain extent, to the smaller importation of perishables, consisting mainly of vegetables.

#### YUKON COUNCIL.

The session of the Yukon Council commenced on July 21 and lasted until August 10. Ten ordinances were passed, among the most important being the Employers' Liability Ordinance. Under the provisions of an amendment to the Yukon Act, which amendment comes into force on May 1 next, the Yukon Council will now consist of ten elected members. There are five electoral districts in the Territory, and two members will be elected for each district. The revision of the lists is now taking place preparatory to the election. The revenue of the Territory for the nine months ending March 31 was \$293,188.97, and the expenditure, \$232,918.88.

#### EDUCATION.

The schools throughout the Territory have been maintained in a high state of efficiency. Under the auspices of the Ontario Department of Education local examinations were held at Dawson for matriculation into Toronto University. The percentage of passes was high, as well as the average of marks obtained. Several graduates of the Dawson high school are now taking courses in arts and engineering at the universities of Toronto, Chicago and Ann Arbor.

#### ADMINISTRATION OF JUSTICE.

I am glad to be able to report that the Territory, during the past year, has been almost entirely free from crime of a serious nature. The members of the Royal Northwest Mounted Police, under the efficient command of the Assistant Commissioner, Major Wood, continue to perform their duties with zeal and promptitude. Although numbers of foreign miners come into the Territory each year, the police protection afforded has been adequate, and no disturbances of any kind have occurred.

#### INDIANS.

The Indians of the Territory have received the care of the government as in the past. An outbreak of small-pox occurred in an Indian tribe near Eagle, Alaska, but the prompt establishment of a quarantine prevented the spread of this dread disease. No sickness of the nature of an epidemic has visited the Yukon Indians during the past year. They are generally hard-working and self-sustaining, living principally by hunting and fishing, but the absence of game in close proximity to their settlements



## SESSIONAL PAPER No. 25

makes it more difficult each year for them to obtain the means of sustenance. It is estimated that the present Indian population of the Territory is about 1,000. Three schools, where elementary instruction and training are given to Indian children, are being conducted by teachers under the auspices of the Church of England.

## GENERAL.

Perhaps the most noticeable feature of the mining industry during the past year has been the increased confidence that the Territory is just about entering on an era of great quartz development. Recent investigations are most gratifying, and within a few months it is believed the question will have been advanced a long way towards solution.

I desire to express my appreciation of the efficient service rendered by all the officials of the different departments of government in the Territory.

Reports from the Comptroller, Gold Commissioner, Crown Timber and Land Agent, Director of Surveys and Government Mining Engineer are herewith inclosed.

I have the honour to be, sir,

Your obedient servant,

ALEXANDER HENDERSON,  
*Commissioner.*

9-10 EDWARD VII., A. 1910

## No. 1.

## REPORT OF THE GOLD COMMISSIONER.

OFFICE OF THE GOLD COMMISSIONER OF THE YUKON TERRITORY,

DAWSON, Y.T., April 21, 1909.

The Commissioner of the Yukon Territory,  
Dawson, Y.T.

SIR.—I have the honour to submit herewith my report for the twelve months ending 31st ultimo.

The total receipts shown by the said report amount to the sum of \$94,236.13, which is a decrease of \$27,009.87 from the receipts of the previous fiscal year. The decrease in question is accounted for principally by the reduction of the fees for renewal of placer mining claims which took effect on July 20 last, and also by the decrease in the receipts from the issuing of placer mining grants and relocation grants, and from the recording of documents.

On the other hand it will be seen from my report that the sum of \$8,815.65 was received in this office during the last fiscal year, whilst no money was received from the same source, namely, rentals for dredging leases, during the previous fiscal year.

Hereto attached will be found also the financial statement, giving the receipts of this office during the said fiscal year, together with the revenues collected at the offices of the mining recorders for the Duncan and Sixtymile mining districts, accounted for during the said fiscal year.

A comparative statement with the receipts of the previous fiscal year will also be found attached to the said financial statement.

Another statement will also be found attached hereto, giving a list of the first locations (generally called discoveries placer mining claims) which have been recorded in the Dawson mining district during the said fiscal year, and the names of the creeks, hills, benches, bars or plains where these locations were made. They number 76 in all, and although they are commonly called discoveries, they are not entitled to be called so in every instance, because the applicants for the same have not established, and have not had to establish to the satisfaction of the mining recorder that they had made a discovery of gold.

The returns for the Duncan mining district, which are embodied in our financial statement, show an increase in placer mining grants and a slight decrease in the receipts from renewal grants and a considerable decrease from relocation grants.

The returns for the Sixtymile mining district show a decrease in the receipts from renewal grants, which is fully accounted for by the reduction of the renewal fee as herein above stated, but the receipts from placer mining grants and relocation placer mining grants are about the same as during the previous fiscal year.

As regards the mining operations which were carried on during the said fiscal year, I do not see any occasion to devote any attention to that matter in this report, as the government mining engineer has prepared a report in that respect which gives, I understand, full particulars.

Your obedient servant,

F. X. GOSSELIN,

*Gold Commissioner.*

## SESSIONAL PAPER No. 25

SCHEDULE showing the placer discovery claims recorded in the Dawson district during the fiscal year ending March 31, 1909.

| Date of Location. | Locator.          | Description of Property.                                 |
|-------------------|-------------------|--|
| 2 April           | Geo. R. Clark     | Hill Dago Gulch, tributary of Hunker.                    |
| 2 "               | Geo. R. Clark     | Bench R. L. Henry Gulch.                                 |
| 3 "               | John Fawcett      | Bar Kimber Island opposite Fort Reliance.                |
| 3 "               | Chas. D. Connor   | Creek David, tributary of Goring.                        |
| 3 "               | D. J. R. Cameron  | Creek Donald, tributary of Black Hills.                  |
| 10 "              | James Archibald   | Creek on tributary of Hunker at 36 below Discovery.      |
| 14 "              | J. T. Rosman      | Creek Dion Gulch, tributary of Yukon.                    |
| 29 "              | Fujiri Wada       | Creek High Cache, tributary of Firth River.              |
| 1 May             | John Bruholski    | Creek Brook, tributary of Clear.                         |
| 15 "              | F. C. Graham      | Creek U $\frac{1}{2}$ Gravel, tributary of Flat.         |
| 15 "              | Murdo Miche       | Creek L $\frac{1}{2}$ Gravel, tributary of Flat.         |
| 21 "              | R. A. Fox         | Creek Log Cabin, tributary of Fortymile.                 |
| 29 "              | Wm. Hayhurst      | Creek Little Dome, tributary of Herbert.                 |
| 2 June            | Joseph Toseo      | Hill R. L. Hubrick, tributary of Hunker.                 |
| 2 "               | F. H. Osborn      | Hill L. L. 4, 5, 6 above Discovery Blackhills.           |
| 10 "              | N. A. Watt        | Creek Spring Gulch, tributary of Bonanza.                |
| 15 "              | Wm. Preido        | Creek Preido Gulch, tributary of Hunker.                 |
| 20 "              | E. Rogers         | Creek on 19 Pup, tributary of Bonanza.                   |
| 26 "              | L. W. Steele      | Creek on tributary at 1 above Discovery Last Chance.     |
| 29 "              | Jas. Sample       | Creek on Slough, tributary of Clear.                     |
| 29 "              | Jas. Sample       | Hill on L. L. Slough.                                    |
| 2 July            | J. H. Baker       | River R. L. Stewart $\frac{1}{2}$ mile below Lake.       |
| 2 "               | L. Matchett       | Creek Dome, tributary of Blackhills.                     |
| 8 "               | T. W. Kirkpatrick | Creek L $\frac{1}{2}$ Windy Bill, tributary of Klondike. |
| 8 "               | H. Kuchman        | Creek U $\frac{1}{2}$ " " "                              |
| 8 "               | T. W. Kirkpatrick | Creek Turgeon, tributary of Windy Bill L $\frac{1}{2}$ . |
| 15 "              | H. Kuchman        | Creek U $\frac{1}{2}$ " " "                              |
| 15 "              | Geo. Hodgins      | Creek Hodgins, tributary of Blackhills.                  |
| 21 "              | Richard Berling   | Creek U $\frac{1}{2}$ Leotta.                            |
| 21 "              | Geo. Waldt        | Creek L $\frac{1}{2}$ Leotta.                            |
| 3 August          | Geo. Hodgins      | Creek Gough, tributary of Blackhills.                    |
| 3 "               | Geo. Hodgins      | Dugas Creek, tributary of Blackhills.                    |
| 3 "               | O. W. Hobbs       | Creek Stephens, tributary of Scroggie.                   |
| 3 "               | W. J. Lee         | Creek L $\frac{1}{2}$ Walhalla, tributary of Scroggie.   |
| 3 "               | C. E. Hirding     | Creek U $\frac{1}{2}$ " " "                              |
| 14 "              | A. B. Thornton    | Creek Moosehorn, tributary of Henderson.                 |
| 18 "              | Thomas Burke      | Creek Milway, tributary of Scroggie.                     |
| 8 Sept.           | Fred. Hurst       | Creek Laporte, tributary of Slough.                      |
| 16 "              | G. M. Brown       | Creek Nodine, tributary of Moose.                        |
| 22 "              | R. W. Brazil      | Creek Brazil, " "  |
| 3 October         | H. E. Boucher     | Canoe, tributary of Blackhills.                          |
| 5 "               | L. G. Preston     | Creek L $\frac{1}{2}$ Britton, tributary of Maisie Mae.  |
| 5 "               | Jas. Britton      | Creek U $\frac{1}{2}$ " " "                              |
| 12 "              | E. J. Corp.       | Creek Corp, tributary of Goring.                         |
| 22 "              | J. L. Walters     | Creek Selwyn, tributary of Yukon.                        |
| 29 "              | J. Butler         | Creek Dixie, tributary of Barker.                        |
| 30 Nov.           | Thomas O'Hara     | Hill R. L. Slough.                                       |
| 2 Dec.            | Wm. Nicoll        | Creek Partridge, tributary of Stewart.                   |
| 3 "               | L. A. Kephart     | Creek Viola, tributary of Maisie Mae.                    |
| 5 "               | W. S. Barkley     | Creek left fork Henderson.                               |
| 14 "              | Alex. Walker      | Bench R. L. Yukon at mouth of Thistle.                   |
| 16 "              | John Shaller      | Creek James, tributary of Log Cabin.                     |
| 16 "              | Richard Burke     | Creek Pete " "   |
| 17 "              | Oswald Heinze     | Creek Heinze, tributary of Blackhills.                   |
| 17 "              | E. A. Froberg     | Creek Barette " "  |
| 21 "              | D. G. Robertson   | Creek Just " "   |
| 29 "              | Duncan McPhail    | Creek Mitchell, tributary of Hunker.                     |
| 29 "              | Duncan McPhail    | Creek Hubrick " "  |
| 29 "              | Duncan McPhail    | Creek Johanna " "  |
| 6 January         | Joseph Butler     | Creek Hines, tributary of Barker.                        |
| 7 "               | Carrie Korbo      | Creek on tributary of Rob Roy.                           |
| 15 "              | O. F. Jenkins     | Creek Franklin, tributary of Barker.                     |
| 15 "              | O. F. Jenkins     | Creek Iron " "   |
| 20 "              | A. O. Backe       | Creek, tributary of Hunker at 77 below Discovery.        |
| 10 February       | S. J. Thurber     | Creek U $\frac{1}{2}$ Preacher, tributary of Barker.     |
| 10 "              | G. E. Nichols     | Creek L $\frac{1}{2}$ " " "                              |
| 19 "              | W. D. McKay, Jr.  | Bar Indian Island in Yukon.                              |
| 19 "              | A. Dunlop         | Hill L. L. Cameron, tributary of Yukon.                  |

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SCHEDULE showing the placer discovery claims recorded in the Dawson district during the fiscal year ending March 31, 1909.—*Concluded.*

| Date of Location. | Locator.                           | Description of Property.              |
|-------------------|------------------------------------|---------------------------------------|
| 3 March..         | J. Tilton .....                    | Creek Durkee, tributary of Yukon.     |
| 3 "               | Percy Dent .....                   | Creek Agate, tributary of McRae.      |
| 12 "              | J. G. Morin .....                  | Creek Jensen, tributary of Dominion.  |
| 13 "              | D. J. McIntyre .....               | Creek Slough.                         |
| 16 "              | C. A. Smith and B. Silverman ..... | Creek Brewer, tributary of Stewart.   |
| 22 "              | Nelson Ponschay .....              | Creek 99 Gulch, tributary of Thistle. |
| 25 "              | O. F. Jenkins .....                | Creek Jenkins, tributary of Yukon.    |
| 25 "              | W. H. Misener .....                | Creek Misener, tributary of Yukon.    |

Certified correct,

G. P. MACKENZIE,

*Mining Recorder.*

FINANCIAL statement of the Gold Commissioner's Office, from April 1, 1908, to March 31, 1909.

RECEIPTS.

|  |    |           |              |
|--|----|-----------|--------------|
| Placer—                                    |    |           |              |
| To Grants .....                            | \$ | 6,140 00  |              |
| Relocations .....                          |    | 4,960 00  |              |
| Renewals .....                             |    | 59,775 00 |              |
| Registered documents .....                 |    | 5,267 00  |              |
| Abstracts .....                            |    | 87 00     |              |
|  |    |           | \$ 67,229 00 |
| Quartz—                                    |    |           |              |
| To Records .....                           | \$ | 1,460 00  |              |
| Certificate of work .....                  |    | 1,215 00  |              |
| Certificate of partnership .....           |    | 72 50     |              |
| Registered documents .....                 |    | 615 00    |              |
| Lieu of assessment .....                   |    | 100 00    |              |
| Certificate of improvements .....          |    | 27 50     |              |
| Acreage .....                              |    | 510 41    |              |
| Abstracts .....                            |    | 4 00      |              |
|  |    |           | \$ 4,004 41  |
| Sundry Accounts—                           |    |           |              |
| To Water grants .....                      | \$ | 950 00    |              |
| Hydraulics .....                           |    | 2,147 09  |              |
| Dredging .....                             |    | 8,815 65  |              |
| Advance deposits .....                     |    | 1,907 98  |              |
|  |    |           | \$ 13,820 72 |
| Duncan—                                    |    |           |              |
| To Placer grants .....                     | \$ | 2,630 00  |              |
| Relocations .....                          |    | 370 00    |              |
| Renewals .....                             |    | 3,405 00  |              |
| Registered documents .....                 |    | 669 00    |              |
| Quartz records .....                       |    | 40 00     |              |
| Quartz registered documents .....          |    | 10 09     |              |
| Water grants .....                         |    | 50 00     |              |
|  |    |           | \$ 7,174 00  |
| Sixtymile—                                 |    |           |              |
| To Placer grants .....                     | \$ | 100 00    |              |
| Relocations .....                          |    | 170 00    |              |
| Renewals .....                             |    | 1,398 00  |              |
| Registered documents .....                 |    | 145 00    |              |
| Quartz records .....                       |    | 20 00     |              |
| Water grants .....                         |    | 175 00    |              |
|  |    |           | \$ 2,008 00  |
| Disbursements—                             |    |           | \$ 94,236 13 |
| By Receiver General .....                  | \$ | 92,159 65 |              |
| Gold Commissioner's Suspense Account ..... |    | 168 50    |              |
| Balance account .....                      |    | 1,907 98  |              |
|  |    |           | \$ 94,236 13 |

Certified correct,

F. A. H. FYSH,

*Accountant.*

## SESSIONAL PAPER No. 25

RECAPITULATION.  
 FINANCIAL Statement Gold Commissioner's Office, Year ending March 31, 1909.

|           | Placer Grants. | Renewals. | Relocations. | Registered Documents. | Abstracts. | Water Grants. | Hydraulics. | Dredging. | Quartz Records. | Certificates of Work. | Certificates of Partnership. | Registration of Documents. | Liens of Assessment. | Certificates of Improvements. | Abstracts. | Average. | Advance Deposits. |
|-----------|----------------|-----------|--------------|-----------------------|------------|---------------|-------------|-----------|-----------------|-----------------------|------------------------------|----------------------------|----------------------|-------------------------------|------------|----------|-------------------|
|           | \$ cts.        | \$ cts.   | \$ cts.      | \$ cts.               | \$ cts.    | \$ cts.       | \$ cts.     | \$ cts.   | \$ cts.         | \$ cts.               | \$ cts.                      | \$ cts.                    | \$ cts.              | \$ cts.                       | \$ cts.    | \$ cts.  | \$ cts.           |
| Dawson    | 6,140 00       | 50,775 00 | 4,960 00     | 5,267 00              | 87 00      | 930 00        | 2,147 00    | 8,815 65  | 1,460 00        | 1,215 00              | 72 50                        | 615 00                     | 100 00               | 27 50                         | 4 00       | 510 41   | 1,907 98          |
| Duncan    | 2,630 00       | 3,405 00  | 370 00       | 689 00                |            | 50 00         |             |           | 40 00           |                       |                              | 10 00                      |                      |                               |            |          |                   |
| Sixtymile | 100 00         | 1,398 00  | 170 00       | 145 00                |            | 175 00        |             |           | 20 00           |                       |                              |                            |                      |                               |            |          |                   |
|           | 8,870 00       | 55,578 00 | 5,500 00     | 6,081 00              | 87 00      | 1,475 00      | 2,147 00    | 8,815 65  | 1,520 00        | 1,215 00              | 72 50                        | 625 00                     | 100 00               | 27 50                         | 4 00       | 510 41   | 1,907 98          |

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## COMPARATIVE STATEMENT.

## RETURNS GOLD COMMISSIONER'S OFFICE.

|   | Year ending        | Year ending        | Increase | Decrease  |
|---|--------------------|--------------------|----------|-----------|
|   | March 31,<br>1908. | March 31,<br>1909. |          |           |
|   | §                  | §                  | §        | §         |
|   | cts.               | cts.               | cts.     | cts.      |
| Placer grants.....                      | 15,180 00          | 8,870 00           |          | 6,310 00  |
| Renewals.....                           | 73,935 00          | 55,578 00          |          | 18,357 00 |
| Relocations.....                        | 7,160 00           | 5,500 00           |          | 1,660 00  |
| Registered documents (placer).....      | 13,444 00          | 6,081 00           |          | 7,363 00  |
| Abstracts.....                          | 59 00              | 87 00              | 28 00    |           |
| Water grants.....                       | 1,250 00           | 1,175 00           |          | 75 00     |
| Hydraulics.....                         | 3,464 67           | 2,147 00           |          | 1,317 58  |
| Dredging.....                           |                    | 8,815 65           | 8,815 65 |           |
| Quartz records.....                     | 2,605 00           | 1,520 00           |          | 1,085 00  |
| Quartz registered documents.....        | 665 00             | 625 00             |          | 40 00     |
| Quartz certificate of work.....         | 747 50             | 1,215 00           | 467 50   |           |
| Quartz certificate of partnership.....  | 67 00              | 72 50              | 5 50     |           |
| Quartz lieu of assessment.....          | 200 00             | 100 00             |          | 100 00    |
| Quartz certificate of improvements..... | 27 50              | 27 50              |          |           |
| Quartz acreage.....                     | 459 60             | 510 41             | 50 81    |           |
| Quartz abstracts.....                   | 2 50               | 4 00               |          | 1 50      |
| Advance deposit.....                    | 1,907 98           | 1,907 98           |          |           |
| Free miner's certificate.....           | 71 25              |                    |          | 71 25     |
|   | 121,246 00         | 94,236 13          | 9,368 96 | 36,378 83 |
| Net decrease.....                       |                    |                    |          | 27,009 87 |

Certified correct.

F. A. H. FYSH,  
Accountant.

## No. 2.

## REPORT OF THE CROWN TIMBER AND LAND AGENT.

OFFICE OF THE CROWN TIMBER AND LAND AGENT OF THE YUKON TERRITORY,  
Dawson, Y.T., April 21, 1909.

The Commissioner of the Yukon Territory,  
Dawson, Y.T.

SIR,—I have the honour to submit herewith my report of the business transacted in this office during the last fiscal year ending on the 31st ultimo, namely:—

1. A statement of revenues in the Timber and Mines Branch amounting to the sum of \$22,158.62.
2. A statement of revenues in the Dominion Lands Branch amounting to the sum of \$8,993.96.

These statements show a total revenue of \$31,058.58 during the said fiscal year from the two sources in question, which is in excess of the revenues collected from the said sources during the previous fiscal year.

Only one coal mine, the Tantalus coal mine, was operated during the said fiscal year.

Seven entries for homestead were granted during the said fiscal year, as against five during the previous fiscal year.

Only one saw-mill, namely, the Klondike mill, owned by the North American Transportation and Trading Company, and situated on the island in the Klondike river at its mouth, was operated last season, by the Yukon Saw-mill Company under a lease.

The wood cutting operations and timber cutting operations along the Lewes, Yukon, Stewart and Klondike rivers, and in the vicinity of Dawson, show about the same activity as in the previous years.

The wood camps within a radius of about ten miles around Dawson were visited several times during the winter by the Crown Timber Inspector, and were generally found operating under proper authority, either on timber berths, or under timber permits, or under contracts from claim owners and operators.

The wood and timber camps up the Klondike river were visited by the Crown Timber Inspector last November, and were found to be operating under proper authority.

Your obedient servant,

F. X. GOSSELIN,  
*Crown Timber and Land Agent.*

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## DOMINION LANDS BRANCH.

| —                   | General Sales. | Rentals. | Registration Fees. | Survey Fees. | Homestead Fees. | Total.   |
|---------------------|----------------|----------|--------------------|--------------|-----------------|----------|
| 1908.               | \$ cts.        | \$ cts.  | \$ cts.            | \$ cts.      | \$ cts.         | \$ cts.  |
| April . . . . .     | 77 90          | 5 00     | 4 50               |              |                 | 87 40    |
| May . . . . .       |                | 1,750 00 |                    |              | 10 00           | 1,760 00 |
| June . . . . .      |                | 2,078 85 | 6 00               |              | 10 00           | 2,094 85 |
| July . . . . .      |                | 2,077 55 |                    |              |                 | 2,077 55 |
| August . . . . .    | 12 00          |          |                    |              | 20 00           | 32 00    |
| September . . . . . | 293 52         |          | 4 00               |              | 20 00           | 317 52   |
| October . . . . .   | 20 00          | 2 66     | 2 00               |              |                 | 24 66    |
| November . . . . .  | 899 59         | 15 00    |                    |              | 10 00           | 924 59   |
| December . . . . .  | 114 67         |          |                    |              |                 | 114 67   |
| 1909.               |                |          |                    |              |                 |          |
| January . . . . .   | 60             |          | 14 00              |              |                 | 14 60    |
| February . . . . .  | 386 33         |          | 2 00               |              |                 | 388 33   |
| March . . . . .     | 77 49          | 1,080 30 |                    |              |                 | 1,157 79 |
|                     | 1,886 10       | 7,009 36 | 28 50              |              | 70 00           | 8,993 96 |

## CROWN TIMBER BRANCH.

| —                   | Royalty. | Timber Permits | Seizures. | Hay Permits. | Coal Royalty. | Total.    |
|---------------------|----------|----------------|-----------|--------------|---------------|-----------|
| 1908.               | \$ cts.  | \$ cts.        | \$ cts.   | \$ cts.      | \$ cts.       | \$ cts.   |
| April . . . . .     | 104 96   | 286 50         | 118 00    |              |               | 509 46    |
| May . . . . .       | 1,197 31 | 358 50         | 189 00    | 32 00        |               | 1,776 81  |
| June . . . . .      | 1,371 83 | 603 65         | 28 50     | 34 00        |               | 2,037 98  |
| July . . . . .      |          | 1,005 50       | 28 00     | 69 00        | 36 52         | 1,139 02  |
| August . . . . .    | 1,019 24 | 825 21         | 76 41     | 5 50         | 77 02         | 2,003 38  |
| September . . . . . | 14 00    | 1,697 00       | 82 00     |              |               | 1,793 00  |
| October . . . . .   | 1,000 18 | 2,488 00       | 174 25    |              | 91 14         | 3,843 57  |
| November . . . . .  | 965 62   | 1,336 00       | 16 00     |              | 167 05        | 2,484 67  |
| December . . . . .  | 10 04    | 886 25         | 40 50     |              |               | 936 79    |
| 1909.               |          |                |           |              |               |           |
| January . . . . .   | 1,175 31 | 285 00         |           |              |               | 1,460 31  |
| February . . . . .  | 1,596 88 | 1,562 00       |           |              |               | 3,158 88  |
| March . . . . .     | 88 25    | 917 00         | 5 50      |              |               | 1,014 75  |
|                     | 8,633 62 | 12,250 61      | 762 16    | 140 50       | 371 73        | 22,158 62 |

Certified correct.

F. A. H. FYSH,  
Accountant.



## No. 3.

## REPORT OF THE COMPTROLLER.

COMPTROLLER'S OFFICE.

DAWSON, Y.T., April 10, 1909.

The Honourable ALEXANDER HENDERSON,  
 Commissioner of the Yukon Territory,  
 Dawson, Y.T.

SIR.—I have the honour to submit my annual report for the year ending March 31, 1909.

Under the appropriation through the Department of the Interior, 'Administration of the Yukon Territory,' the expenditure for the fiscal year just ended was \$148,695.74, as shown by the monthly statements and vouchers forwarded to the department.

On account of subsidy to river steamers, the amount expended was \$750, the unexpended balance being deposited to the credit of the Receiver General, this vote having been discontinued.

From July 1, 1908, to March 31, 1909, the local revenues and expenditures of the Yukon Territory were:—Revenue, \$293,188.97; expenditure, \$232,918.88, as per balance sheet attached. Statements and vouchers were forwarded to the Auditor General at the end of each quarter as required by the ordinance.

The expenditure on account of the Department of Justice for the year just closed was \$24,739.08; monthly returns being made to that department.

The expenditure on account of Department of Indian Affairs for the relief of sick and destitute Indians was \$6,936.

Under the Letter of Credit account, Department of Public Works, for the maintenance and repairs of public buildings, in the name of the Superintendent of Public Works and myself, the expenditure was \$89,658.78.

From the vote for river improvements, in the name of the Commissioner and myself, the expenditure was \$5,054.12.

The royalty collected in the Territory for the year ending March 31, amounted to \$81,502.92; collected at Dawson, \$79,791.02, Whitehorse, \$1,711.15, and Fortymile, 75 cents.

The revenue from free certificates issued to exporters of gold from Alaska was \$166.

From confiscated gold dust, there was a sum of \$75.50 realized.

The revenue from these sources was deposited to the credit of the Receiver General, drafts being sent to the department weekly and statements at the end of each month.

From the sale of Yukon Territorial Court law stamps, the revenue received was \$3,344.

The returns of the revenue received in the office of the Gold Commissioner and Crown Timber and Land Agent have been checked each month as formerly, and returns forwarded to the department; the suspense account in the Gold Commissioner's office also being checked monthly and the cheques countersigned in payment of disbursements.

In accordance with your instructions, I made a thorough and exhaustive inspection of the office of the Mining Recorder for the Duncan mining district. A copy of my report was forwarded to the department under date of March 30.

Your obedient servant,

J. T. LITHGOW,  
*Comptroller.*

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## BALANCE SHEET GOVERNMENT OF YUKON TERRITORY, MARCH 31, 1909.

| Appropriation.     | Dr.  | Expenditure.      |            |
|--------------------|--|-------------------|------------|
| \$ cts.            |  | \$ cts.           |            |
|                    | Balance from 1907-08.....                        | 271 46            |            |
| 23,500 00          | Salaries and travelling expenses.....            | 16,071 10         |            |
| 49,500 00          | Schools.....                                     | 32,935 12         |            |
| 5,000 00           | Contingencies.....                               | 3,166 56          |            |
| 4,300 00           | Dawson free library (Terry).....                 | 3,125 00          |            |
| 107,090 00         | Roads, bridges and public works.....             | 88,443 39         |            |
| 13,600 00          | Election of 10 members Yukon Council.....        | .                 |            |
| 4,000 00           | Indemnity " ".....                               | 3,060 00          |            |
| 950 00             | Preventive service.....                          | 621 64            |            |
| 5,000 00           | Printing and Stationery (Terry).....             | 2,132 06          |            |
| 900 00             | Whitehorse free reading room.....                | 600 00            |            |
| 34,600 00          | Hospitals, charities and quarantine.....         | 25,389 02         |            |
| 4,600 00           | Assay office, Whitehorse.....                    | 2,432 00          |            |
| 5,000 00           | Miscellaneous expenditure.....                   | 2,974 85          |            |
| 10,500 00          | Town of Whitehorse.....                          | 9,924 90          |            |
| 3,500 00           | Street lighting (city).....                      | 2,770 30          |            |
| 500 00             | Printing and stationery (city).....              | 246 75            |            |
| 2,100 00           | Dawson free library ".....                       | 1,575 00          |            |
| 34,300 00          | Dawson fire department ".....                    | 24,313 87         |            |
| 10,000 00          | Streets and sidewalks ".....                     | 8,347 75          |            |
| 1,000 00           | Contingencies ".....                             | 392 63            |            |
| 4,700 00           | Salaries ".....                                  | 3,524 94          |            |
| 2,000 00           | Dog pound ".....                                 | 842 00            |            |
|                    | Balance on Hand.....                             | 59,998 63         | 293,188 97 |
| Estimated Revenue. | Cr.  | Revenue Received. |            |
| \$ cts.            |  | \$ cts.           |            |
| 59,375 00          | Dominion Government grant roads and bridges..... | 50,000 00         |            |
| 125,000 00         | " " " local purposes.....                        | 93,750 00         |            |
| 23,500 00          | Liquor licenses (Terry).....                     | 38,420 30         |            |
| 35,000 00          | " permits.....                                   | 46,347 26         |            |
| 16,000 00          | Local taxation and Sundry Revenue.....           | 15,651 70         |            |
| 21,500 00          | Proportion liquor licenses (city).....           |                   |            |
| 5,000 00           | City licenses.....                               | 756 00            |            |
| 40,625 00          | City taxation.....                               | 48,263 71         | 293,188 97 |

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## No. 4.

## REPORT OF THE GOVERNMENT MINING ENGINEER.

DAWSON, Y.T., April 1, 1909.

The Commissioner of the Yukon Territory,  
Dawson, Y.T.

SIR,—I have the honour to submit to you my annual report on the mining operations in the Yukon Territory for the year ending March 31 last.

The mining conditions have not, within the last year, changed very materially, at least not more than what would be expected in a placer camp of this age. In the districts of early gold discoveries the transition period, which has been in existence for the last few years, is nearly completed. The individual miner who worked the cream of the pay has given way to the large operator and gone to develop the outlying districts. This has been the case in that part of the Dawson mining district tributary to the Klondike river; that portion tributary to Indian river is gradually undergoing the same change, such as the upper part of Dominion creek and the upper part of Sulphur creek, and will likely last until the claims are consolidated and the plants installed on them.

Miller and Glacier creeks, tributaries of the Sixty-mile river, situated in the Sixty-mile district, are also in a stage of transition similar to that part of the Dawson mining district tributary to Indian river. Nearly the whole of Miller creek is included in a leasehold acquired by the N. A. T. & T. Company, which is now preparing the creek bed for dredging operations in the near future. There are a few claims situated on Miller creek, outside the limits of this leasehold, but there is very little work being done on them. All the claims situated on Glacier creek are rapidly being consolidated.

The number of productive mining operations on the old gold-bearing streams, which are still in a stage of transition are few, and such a condition is expected to last until there is a complete consolidation of the claims in these particular localities. In many instances there is only enough work being done, as required by the Placer Mining Act, to keep the claims in good standing.

With the aid of the grouping system, for the purpose of consolidation, it is possible to apply all the work of one plant as representation work for any number of claims in the group. It is obvious that many have taken advantage of this section of the regulations, and really abused it in order to avoid representation work, and it has, naturally, lessened the number of operations in the Territory. On the other hand it has helped many miners of limited means who are sinking in very deep ground, which has been the means of locating pay streaks which could not otherwise be found, and I must say that the conditions at present demand such a grouping system to be kept in force.

## INDIVIDUAL MINING OPERATIONS.

The bulk of individual mining is still confined to the Dawson mining district. Apart from the few plants scattered here and there on the old gold-bearing streams upon which large operations are concentrated, as on Bonanza, Eldorado, Hunker, and in those parts of the Territory where consolidation of claims is being made, as on the upper part of Dominion creek, the upper part of Sulphur creek and a portion of Miller and Glacier creeks, the individual mining done, from which the main output is derived, is confined to the lower portion of Dominion creek, the middle of Sulphur creek, the lower portion of Gold Run creek, the whole of Quartz creek, the upper parts of Black Hills creek and some of the tributaries of Hunker creek.

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Black Hills creek, a tributary of Stewart river, is productive from Discovery to No. 23 above discovery. I am informed that pay has been located at four places in the lower portion of the creek, but no output is expected this coming year from the lower portion.

It is estimated that the spring wash-up and the summer work on this creek during the last year gave an output of \$45,000.

Livingston creek, a tributary of the South Fork of the Big Salmon river, is a steady producer. Over fifteen outfits were operating during the summer, and many are prospecting this winter. There is a transient population of 300 during the summer months and a stationary one of over 150 during the winter. The estimated output during the last year was \$100,000.

You will find herewith attached (Table No. 1), in a tabulated form, the number of individual mining operations conducted during the last year within the several mining districts in the Yukon Territory, together with the methods employed, and a few remarks on the existing conditions in each locality.

#### LARGE SCALE OPERATIONS.

These operations include dredging, hydraulicking, steam shovelling and electric elevators, or any other method employed whereby mechanical appliances have been substituted for manual labour; therefore, these operations are expected to be situated in localities where the individual miner could not operate any more at a profit or where the tenor of the gravels was too low grade for individual operations ever to be attempted.

The existing fields for these large operations are, at present, on Bonanza creek, Hunker creek, the hills and benches bordering on these streams and tributaries and in the valleys of the Klondike, Indian, Stewart and Fortymile rivers.

#### DREDGING.

The operation of dredges in frozen ground has been materially improved both in the manner of digging and in the way of thawing ahead of the dredges. The cost of thawing has been reduced fully 50 per cent, due principally to cheaper transportation of the fuel and the increase of point duty. The reduction in the cost of digging is due to the installation of hydro-electric transmission plants.

Most improvements have been made in the manner of digging. Where the bed-rock is soft and the gold is evenly distributed through the gravels the manner of digging has not changed, but as the gold, in this territory, is invariably close to or in bed-rock the manner of digging has been made to conform to the conditions of the bed-rock.

In localities where the bed-rock is hard, cracked and slabby it has been found necessary to go over the same area twice; the first time the buckets will take up all the material possible and 'bull dose' the bed-rock and the second time the bed-rock material itself will be taken up. Some dredge men have found it impossible to take up everything, in the shape of values, by going over only once.

You will find in Table No. 2, in a tabulated form, the number of dredges in operation in this territory together with other data in connection with the operations.

#### HYDRAULICKING.

There have been no new improvements in either the manner of working or the gold-saving appliances employed. In spite of the wet season during the last year the number of hydraulic operations was less than the previous year. This was due to the Yukon Gold Company having acquired many of the small hydraulic outfits which were operating during the previous year. There will be no increase in the number of hydraulic operations until the Yukon Gold Company has completed its water system, which will be in the course of a couple of years.

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Although the past season was a most favourable one for the hydraulic operator, it is only local water which is used, and the supply is not sufficient at its best. The dam constructed by the Yukon Gold Company at No. 57 above Discovery on Bonanza creek conserved all the water available to operate the hill and bench gravels of upper Bonanza creek, but there was not enough for all the hills and the elevators that were installed in the creek bed.

You will find herewith attached, in Table No. 3, in a tabulated form, the number of hydraulic operations conducted during the past season, together with some other data in connection therewith.

## ELECTRIC ELEVATORS.

There are three elevators installed in the territory, two on Bonanza creek, owned by the Yukon Gold Company, and the other one on Hunker creek, owned by Messrs. Burke Bros. The Yukon Gold Company operates its elevators with electric power transmitted over its line from Little Twelvemile river, where the hydro-electric plant is situated; the other has steam as a motive power.

These elevators will do as much work as a dredge, cost less and will also operate in localities where the conditions are inimical to dredging. They are installed for the purpose of operating shallow creek diggings where the bed-rock is slabby and hard and where there is no grade for the disposal of the tailings.

All the water used must be under pressure the same as in hydraulic operations. It is an open-cut mining method and subdivided into an hydraulic method.

All the elevators have proved successful. Considerable trouble was encountered with the pumps, which would plug up with moss and other waste material when the overburden was removed, but I am informed that this trouble will be obviated during the coming season, as other pumps have been installed for the purpose.

You will find in Table No. 2, in a tabulated form, the depth and area of ground worked, the quantity of water used and other data in connection therewith.

## THE ASSAY OFFICE.

The Assay Office is situated in the town of Whitehorse, and is controlled by the local government. It is in charge of Mr. Robert Smart, whose work has been entirely satisfactory to both the public and the several smelting companies.

During the year, 806 assays were made sent from different parts of the Territory and Atlin, B.C. In addition to the above number of assays many qualitative determinations of ores were made which are not herewith tabulated.

The capacity of the office has been materially increased in the way of a 3 horse-power gasoline engine for pulverizing and crushing.

There was a decrease in the number of assays made this year in comparison with the last year, and that is due, no doubt, to the lack of prospecting for copper ores, on account of the great reduction in price.

As we have no assay office in Dawson, all samples received here are sent to Whitehorse, through the White Pass Company, for assay.

You will find herewith attached, in Table No. 4, in a tabulated form, a statement of the number of assays made during the year.

Your obedient servant,

A. J. BEAUDETTE,  
*Government Mining Engineer.*

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TABLE NO. 1.—INDIVIDUAL MINING OPERATIONS.

| Main Creek.             | LOCALITY.     | Tributaries.                                  | Number of Operations and the Mining Methods Employed. |                            |           |        | Remarks.   |    |
|-------------------------|---------------|---|---|----------------------------|-----------|--------|--|----|
|                         |               |   | Dripping.   | Open-cutting.              | Shafting. | Total. |  |    |
| Dawson Mining District. | Bonanza Creek | Lovett Gulch.....                             | 41  | 3                          | 8         | 52     | All the operations herewith tabulated are conducted by manual labour. With the exception of the self-dumper, to elevate the material to the shafts, and the scraper, to remove the overburden, there are no mechanical appliances employed. In many instances, if the conditions will allow, the method of ground-shafting is employed to remove the overburden of placer claims when the pay underneath is to be excavated with the pick and shovel. In other instances the whole of the claim, from top to bottom, is washed into the shafts and the pay is recovered in that way.<br>Each operation herewith tabulated represents, in most cases, a group of placer claims ranging from two to upwards of twenty in number and a shift of from two to twenty men. Many of these men work on the productive claims in the summer and prospect in the winter.<br>In the Bonanza Creek bed there are nine individual mining operations, five dredges and two electric elevators. All the claims now lying idle are kept in good standing by reason of being grouped with the claims operated.<br>As only one claim can be worked at a time many of them are bound to be idle for a number of years to come. No one claim will justify the expenditure of either a dredge, an electric elevator or an hydraulic plant.<br>In the Hunker Creek bed there are twenty individual mining operations, three dredges and one steam elevator. The conditions on this creek are precisely the same as they are on Bonanza Creek. The bulk of the individual mining operations is on the upper part of Quartz Creek, the middle of Sulphur Creek, and the lower part of Dominion Creek. The work on the other creeks is not concentrated at any one point, but is more or less scattered from mouth to head. |    |
|                         |               | Trail Gulch.....                              | 8   |                            |           | 8      |  |    |
|                         |               | Adams Creek.....                              | 3   |                            | 1         | 4      |  |    |
|                         |               | Stamper Gulch.....                            | 4   | 1                          |           | 5      |  |    |
|                         |               | Little Skookum.....                           | 2   |                            | 2         | 4      |  |    |
|                         |               | Big Skookum.....                              | 1   |                            |           | 1      |  |    |
|                         |               | Homesake Gulch.....                           | 2   |                            |           | 2      |  |    |
|                         |               | Victoria Gulch.....                           | 1   | 3                          | 2         | 6      |  |    |
|                         |               | No 7 Pup, on Victoria.....                    |   | 9                          | 2         | 11     |  |    |
|                         |               | Eldorado Creek.                               |   | Irish Gulch.....           | 5         |        |  | 1  |
| French Gulch.....       | 3             |   |   |                            |           | 3      |  |    |
| Nugget Gulch.....       | 1             |   |   |                            |           | 1      |  |    |
| Gay Gulch.....          | 4             |   |   | 1                          |           | 5      |  |    |
| Ora Grande.....         |               |   |   |                            | 2         | 2      |  |    |
| Chief Gulch.....        | 1             |   |   |                            | 1         | 2      |  |    |
|                         | 10            |   |   | 12                         |           | 22     |  |    |
|                         | 12            |   |   | 2                          |           | 14     |  |    |
|                         | 2             |   |   | 1                          | 1         | 4      |  |    |
|                         | 2             |   |   | 2                          |           | 4      |  |    |
| Hunker Creek.           |               | Last Chance Creek.....                        |   |                            | 2         | 2      |  |    |
|                         |               | Henry Gulch.....                              | 2   | 1                          |           | 3      |  |    |
|                         |               | Discovery Pup (tributary).<br>No. 80 Pup..... | 2   | 2                          |           | 4      |  |    |
|                         |               | Hattie Gulch.....                             | 2   |                            |           | 2      |  |    |
|                         |               | Hester Creek.....                             | 2   |                            | 1         | 3      |  |    |
|                         |               | Independence Creek.....                       |   |                            | 1         | 1      |  |    |
|                         |               | Gold Bottom Creek.....                        | 4   | 1                          |           | 5      |  |    |
|                         |               | Rogers Pup.....                               |   | 8                          |           | 8      |  |    |
|                         |               | Dominion Creek.                               |   | Little Dominion Creek..... | 80        |        |  | 80 |
|                         |               |   |   | Caribou Creek.....         | 2         |        |  | 2  |
| Gold Run Creek.....     | 1             |   |   |                            | 1         | 2      |  |    |
| Lombard Creek.....      | 14            |   |   |                            |           | 14     |  |    |
|                         | 2             |   |   |                            |           | 2      |  |    |

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Many of the outfits here tabulated are merely taking enough gold out of their claims, or on lays for grubstake purposes, and consequently they do not figure very much in the output. The amount taken out by these searchers of grubstakes ranges from \$800 to \$2,000 for every two men.

The submerged bed of the Fortymile River is being dredged at a point about six miles above the mouth.

Bar digging operations are still being conducted on the Fortymile and Stewart Rivers with success, but that can only be done at low water.

On Dominion Creek, from the mouth of Gold Run Creek to creek claim No. 132 below lower discovery, a distance of about seven miles, there is no work going on and it does not appear that any will be done in the near future. From creek claim No. 132 below lower to the head of the creek the operations are very scattered. Most of the claims lying idle are kept in good standing by reason of the work being done on adjoining claims to which they are grouped.

The number of placer mining outfits of all kinds in operation in the Dawson mining district is, as near as I can find, 473.

Only individual mining is being done in this district, and it does not appear that any other class of mining will be attempted in the near future, although I just received some information that a company is contemplating installing a dredge at the mouth of the McQuesten River.

The prospectors in this district have been very unfortunate in that the deposits are deep and only partly frozen, the unfrozen part being near bedrock, and admit uncontrollable quantities of water, which makes it impossible for a miner of limited means to make a success.

The greater portion of the miners on Duncan Creek have gone away from the district on account of the wet ground, above mentioned. The pumps installed by the government on Duncan Creek were not a success, as the quantity of water to be controlled was too great. Some fairly good pay was found on Haggart Creek last year, which created quite a stampede. I was there last year shortly after the pay was discovered and again this winter. There are nine different outfits sinking on the benches and so far only one has found enough pay to justify drifting.

I saw some shafts being sunk which were 121 feet in depth and gravel had not yet been reached.

Of the fifteen outfits mentioned in the table herewith, only four are producing gold.

The conditions and the quantity of work done in the Sixtymile district have not changed within the last year.

|                                  |    |    |    |
|----------------------------------|----|----|----|
| Indian River                     | 1  | 3  | 4  |
| Sulphur Creek                    | 35 | 2  | 35 |
| Green Gulch (tributary)          | 2  | 1  | 2  |
| Bureka Creek                     | 4  | 2  | 5  |
| Quartz Creek                     | 25 | 1  | 27 |
| Little Blanche Creek (tributary) | 1  | 1  | 3  |
| Canyon Creek (tributary)         | 3  | 1  | 3  |
| Claffy Pup (tributary)           | 1  | 1  | 2  |
| Goring Creek                     | 2  | 1  | 2  |
| All Gold Creek                   | 3  | 2  | 5  |
| Henderson Creek                  | 2  | *3 | 3  |
| Barker Creek                     | 4  | 1  | 5  |
| Serggie Creek                    | 2  | 1  | 5  |
| Black Hills Creek                | 18 | 1  | 19 |
| Child's Gulch                    | 4  | 1  | 4  |
| Summit Creek                     | 3  | 1  | 5  |
| Livingstone Creek                | 14 | 1  | 15 |
| Lake Creek                       | 3  | 2  | 3  |
| Thistle Creek                    | 15 | 1  | 17 |
| Russell Creek                    | 1  | 1  | 1  |
| Moose Creek                      | 3  | *1 | 3  |
| Bear Creek                       | 3  | 1  | 3  |
| Falls Creek                      | 4  | 1  | 4  |
| 469                              |    |    |    |
| Vancouver Creek                  | 1  | 1  | 2  |
| Haggart Creek                    | 14 | 1  | 15 |
| Dublin Gulch (tributary)         | 1  | 1  | 1  |
| Minto Creek                      | 2  | 2  | 4  |
| Hightet Creek (tributary)        | 3  | 1  | 4  |
| Davidson Creek                   | 2  | 1  | 2  |
| Ledge Creek                      | 1  | 1  | 1  |
| Duncan Creek                     | 2  | 1  | 3  |
| 28                               |    |    |    |
| 31                               |    |    |    |
| Miller Creek                     | 4  | 1  | 4  |
| Glacier Creek                    | 4  | 4  | 8  |
| Big Gold Creek                   | 2  | 1  | 3  |
| Ten-mile Creek                   | 1  | 1  | 1  |
| Bedrock Creek                    | 1  | 1  | 1  |
| 17                               |    |    |    |

Duncan Mining District.

Sixtymile Mining District.

\*Bar diggings.

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TABLE No. 2.  
DREDGING OPERATIONS.

| Name of Company.                         | Locality.                               | Capacity of Buckets. | Condition of Gravel.      | Type of Dredge.          | Days in Operation. | Output, Cu. Yds. |
|--|---|----------------------|---------------------------|--------------------------|--------------------|------------------|
| Yukon Gold Company.....                  | 104 B. D. Bonanza Creek .....           | 5 cu. ft.            | Thawed ahead of dredge    | Bucyrus .....            | *                  | .....            |
| " .....                                  | 104 " " .....                           | 5 " "                | " "                       | " .....                  | "                  | .....            |
| " .....                                  | 90 " " .....                            | 5 " "                | " "                       | " .....                  | "                  | .....            |
| " .....                                  | 85 " " .....                            | 7 " "                | " "                       | " .....                  | "                  | .....            |
| " .....                                  | Mouth of Hunker Creek.....              | 7 " "                | " "                       | " .....                  | "                  | .....            |
| " .....                                  | Anderson Concession, Hunker Creek ..... | 7 " "                | " "                       | Marion Shovel Co. .....  | "                  | .....            |
| " .....                                  | 37 B. D. Hunker Creek .....             | 7 " "                | " "                       | " .....                  | "                  | .....            |
| Canadian Klondike Mining Company.....    | Klondike River Valley.....              | 7½ " "               | No thawing required.....  | " .....                  | 155                | 450,000          |
| Bonanza Basin Gold Dredging Company..... | " " .....                               | 6½ " "               | " "                       | Allis Chalmers .....     | 110                | 200,000          |
| Lewis River Gold Dredging Company .....  | 6 B. D. Bonanza Creek.....              | 3½ " "               | Thawed ahead of dredge    | Risdon Iron Works .....  | 136                | 150,000          |
| Davidson Bros .....                      | Fortymile River, submerged bed.....     | 6½ " "               | No thawing required ..... | Allis Chalmers .....     | 120                | 225,000          |
| Yukon Basin Gold Dredging Company .....  | Stewart River, submerged bed .....      | 3½ " "               | " "                       | Risdon Iron Works .....  | 14                 | No information.  |
| Indian River Development Company .....   | Indian River Valley .....               | 2½ " "               | Thawed ahead of dredge    | Robinson, McIntire ..... | 60                 | "                |

\* I have no information as to the number of days each dredge worked or its output, but the number of cubic yards excavated was 1,500,000 for the whole fleet.

ELECTRIC ELEVATOR OPERATIONS.

|                         |                               |            |                           |                      |       |        |
|-------------------------|-------------------------------|------------|---------------------------|----------------------|-------|--------|
| Yukon Gold Company..... | 3-A. A. D. Bonanza Creek..... | 2½ cu. ft. | No thawing required ..... | Special Patent ..... | ..... | 60,000 |
| " .....                 | 30 B. D. Bonanza Creek.....   | 2½ " "     | " "                       | " .....              | ..... | 8,000  |
| Burke and Company.....  | 17 B. D. Hunker Creek.....    | 2½ " "     | " "                       | " .....              | 29    | 39,725 |



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TABLE No. 3.  
HYDRAULIC OPERATIONS.

| Name of Operator.              | Locality.                           | Length of Ditch.         | Capacity of Ditch.        | Pressure of Water. |
|--------------------------------|-------------------------------------|--------------------------|---------------------------|--------------------|
| Yukon Gold Company             | Acklen Farm, R. L. Klondike River.  | 7½ miles.                | 1,000 miner's inches.     | 360 feet.          |
| "                              | Paradise Hill, L. L. Hunker Creek.  | 4 "                      | 300 "                     | 75 "               |
| "                              | American Hill, L. L. Bonanza Creek. | 8 "                      | 1,000 "                   | 250 "              |
| Bonanza Creek Mining Company   | Adams Hill, L. L. Bonanza Creek     | 34 "                     | 800 "                     | 175 "              |
| O. R. Brener                   | French Hill, Eldorado Creek         | 2 ditches, 3 and 4 miles | 500 miner's inches in all | 150 "              |
| Canadian D. and H. Company.    | Lovett Hill, R. L. Bonanza Creek.   | 2½ miles                 | 150 inches.               | 150 "              |
| Groscheier Concession.         | Leasehold, L. L. Klondike River.    | 1½ "                     | 150 miner's inches.       | 75 "               |
| Yankins, J.                    | Hill, L. L. Last Chance Creek.      | 3 "                      | 300 "                     | 75 "               |
| Ellbeck & Collins              | " "                                 | 31 "                     | 290 "                     | 100 "              |
| Dolan, <i>et al.</i>           | " "                                 | 31 "                     | 290 "                     | 100 "              |
| Cook, <i>et al.</i>            | " "                                 | 32 "                     | 250 "                     | 80 "               |
| Elliot, <i>et al.</i>          | Paradise Hill, Hunker Creek         | 4 "                      | 300 "                     | 75 "               |
| Murphy and Gould               | Nugget Hill, L. L. Hunker Creek     | 24 "                     | 150 "                     | 75 "               |
| Larson, A.                     | Temperance Hill, Gold Bottom Creek  | 14 "                     | 150 "                     | 75 "               |
| De Blegter and Company         | " "                                 | 4 "                      | 200 inches.               | 100 "              |
| Barke, <i>et al.</i>           | Whisky Hill, R. L. Hunker Creek     | 1½ "                     | 150 miner's inches.       | 75 "               |
| William's Concession.          | Hills, R. L. Hunker Creek.          | 9 "                      | 300 inches.               | 150 "              |
| Delbie, <i>et al.</i>          | Hills, L. L. Hunker Creek.          | 43 "                     | 300 "                     | 100 "              |
| Greiser Bros                   | Hill, L. L. Dominion Creek.         | 1 "                      | 75 miner's inches.        | 75 "               |
| Kellner and Steffens           | Hill, R. L. Quartz Creek.           | 2 "                      | 100 "                     | 50 "               |
| Canadian D. and H. Company.    | Hill, L. L. Bonanza Creek.          | 3 "                      | 200 "                     | 100 "              |
| Finlayson, E. O.               | Hill, L. L. Klondike River.         | 6 "                      | 300 "                     | 150 "              |
| J. W. Park                     | Hill, L. L. "                       | 5½ "                     | 75 inches                 | 75 "               |
| Ballarat Creek Mining Company. | Leasehold, Ballarat Creek           | 5 "                      | 300 miner's inches.       | 175 "              |
| Yukon Gold Company.            | Hill, L. L. Bonanza Creek.          | 4 "                      | 500 "                     | 150 "              |

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TABLE No. 4.

Assays made in the Government Assay Office, Whitehorse, Y.T., during the Year ending March 31, 1909.

| Elements.           | April, 1908. | May, 1908. | June, 1908. | July, 1908. | Aug., 1908. | Sept., 1908. | Oct. 1908. | Nov., 1908. | Dec., 1908. | Jan., 1909. | Feb., 1909. | March, 1909. | Total. |
|---------------------|--------------|------------|-------------|-------------|-------------|--------------|------------|-------------|-------------|-------------|-------------|--------------|--------|
| Gold and silver     | 11           | 25         | 131         | 73          | 81          | 96           | 52         | 23          | 13          | 9           | 18          | .....        | 532    |
| Copper.....         | 5            | 18         | 81          | 19          | 24          | 48           | 21         | 16          | 2           | 2           | 6           | .....        | 242    |
| Lead.....           |              |            | 1           |             | 2           |              |            |             |             |             |             |              | 3      |
| Antimony.....       | 1            |            | 1           |             | 8           | 6            |            |             |             |             |             |              | 16     |
| Manganese.....      |              |            |             | 1           |             | 2            |            |             |             |             |             |              | 3      |
| Nickel.....         |              |            |             |             |             |              |            |             |             | 1           |             |              | 1      |
| Platinum.....       |              |            |             |             |             |              | 1          |             |             |             |             |              | 1      |
| Carbon.....         |              |            |             |             |             |              | 3          |             |             |             |             |              | 3      |
| Magnesia.....       |              |            |             |             |             |              |            |             |             | 1           | 1           |              | 2      |
| Aluminum.....       |              |            |             |             |             |              |            |             |             |             | 1           |              | 1      |
| Calcium.....        |              |            |             |             |             |              |            |             |             |             | 1           |              | 1      |
| Carbon dioxide..... |              |            |             |             |             |              |            |             |             |             | 1           |              | 1      |
| Totals.....         | 17           | 43         | 214         | 93          | 115         | 152          | 77         | 39          | 15          | 13          | 28          | .....        | 806    |

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## No. 5.

## REPORT OF THE DIRECTOR OF SURVEYS.

SURVEY OFFICE, YUKON TERRITORY,

DAWSON, Y.T., April 12, 1909.

The Hon. ALEXANDER HENDERSON, K.C.,  
 Commissioner of the Yukon Territory,  
 Dawson, Y.T.

SIR,—I have the honour to submit the following report of the work done in the Survey Department for the year ending March 31 last.

The staff has consisted of Mr. Gibbon, Captain Bennet and myself. Captain Bennet relieved the correspondence clerk during part of January, February and March while the latter was absent on leave.

During the year traverses were made of the location on 'Tab Hill,' 'McInnes Hill' and on Indian River from No. 10 above 'Hobbs' Discovery to the mouth, a distance of about ten miles. In the above instances staking and restaking had taken place until it was quite impossible for the mining recorder to ascertain by description, as given by the stakers, if grants were being given to more than one applicant for the same ground.

These traverses proved of valuable assistance to the gold office, for which plans were furnished. Mr. Gibbon also made traverse of the location stakes on a portion of Moose creek in the Fortymile district for the same purpose.

During July, August and September Mr. Gibbon established thirty-four miles of base lines on Black Hills creek and its tributaries, including end boundaries of claims, returns of which will soon be ready to file. Base lines were established on a portion of Black Hills creek in the spring of 1901 by Mr. Cautley, D.L.S., under contract made with Mr. Ogilvie, who was about that time succeeded by Commissioner Ross, who considered the survey too expensive and did not have Mr. Cautley make the returns. The lines established by Mr. Cautley were used as far as possible by Mr. Gibbon.

I surveyed base lines on 'Examiner Gulch,' 'Dion Gulch' and 'Falconer Gulch,' returns of which are being prepared. 'Examiner Gulch' is a tributary on the left limit of Bonanza at No. 98 below Discovery. 'Falconer Gulch' and 'Dion Gulch' are the first two tributaries of the Yukon river on its right limit above the Klondike river.

Captain Bennet has been employed in general office work draughting and keeping up as far as possible compiled sheets of the surveys brought into the office, making tracings and blue-prints of plans on file, and giving general information to the public, which by the way occupies almost half the time of one clerk.

A large plan was compiled by Capt. Bennet and myself of the whole territory, showing all the general topography at present to hand and particularly the location of all roads and trails that have been constructed in the territory. The plan also contains a table showing the number of miles of roads and trails constructed and the year in which they were made.

This map was made for the information and at the request of the Minister of the Interior.

Plans and returns of the following surveys were filed in this office during the past year :—

|   |     |
|---|-----|
| Group lots including quartz claims. . . . . | 124 |
| Advertised placer claims. . . . .           | 24  |
| Base lines and traverses. . . . .           | 11  |

These include surveys made by surveyors in private practice in the territory. There were also 168 blue-prints and 87 tracings made in the office.

Your obedient servant,

C. W. MACPIERSON.

*Director of Surveys, Y.T.*

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## No. 6.

## -REPORT OF THE ASSISTANT GOLD COMMISSIONER.

OFFICE OF THE ASSISTANT GOLD COMMISSIONER,

WHITEHORSE, Y.T., April 16, 1909.

The Hon. ALEXANDER HENDERSON,  
 Commissioner of the Yukon Territory,  
 Dawson, Y.T.

SIR,—I beg to submit the following report concerning the development and general conditions existing in the southern Yukon, including the Whitehorse, Conrad and Kluane districts, during the past year, and also concerning the prospects and possibilities for the coming year.

## WHITEHORSE DISTRICT.

During the first several months of last year the White Pass Railway continued work on the spur from its main line to the Whitehorse copper belt, completing seven miles of track. This line is now in a position to serve the southern half of the above belt but up to date none of the mine owners in that section have seen fit to ship ore. This is undoubtedly owing to two facts, first the low price of copper, and second, the very high freight rate demanded by the above railway. Prior to 1908 the ore rate from Whitehorse to the smelters was \$5 per ton for sacked ore and \$6 for ore in bulk. At present the railway ask \$13.50 from Carcross to the smelter, and from Whitehorse to smelter from \$5 per ton for ore valued at \$8 per ton to \$30 per ton and over on higher grades of ore.

The only properties on the Whitehorse belt that worked during 1908-9 were the Copper King and the War Eagle, the former shipping 300 tons of ore, valued at \$11 per ton, but losing money by so doing.

On the whole it may be said that the Whitehorse copper belt has not developed at all during the last year, neither of the claims worked having made much progress. For the number of quartz and copper claims in good standing in this district, see Table No. 1 and for general data concerning principal claims see Table No. 2.

The Big Salmon Placer district produced about \$60,000, employing about 50 men. No new discoveries were made in this district and it is probable that the coming year will be much the same as last. For general information as to quantity and value of gravel in this district see Table D.

The collections on account of timber and land were greater than during the previous year and the overdue payments on land have been practically all met. Only one application for a homestead entry was filed during the year. For total collections from all sources for the year see Table No. 5.

## CONRAD DISTRICT.

In the Windy Arm section of the above district the Yukon District Gold Mining Company, successor to the Conrad Consolidated Company, is installing a 60-ton concentrating mill at a cost of \$60,000 and is developing several other properties to a considerable extent and with encouraging results. For general data concerning the mining operations in this section see Table No. 2 (from Venus claim to end of table). The Wheaton and Watson Divisions of the Conrad District have been rather quiet, although the small operations carried on in these sections have given the operators every encouragement. For general data respecting mines in these divisions see Table

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No. 2 (Gold Hill to Tally-Ho claim inclusive). For total collections made in the Conrad office for the year see Table No. 6. There will be little or no work in this district under the present ore rate. If, however, the railway company meets the miners half way the whole district will undoubtedly be very active.

## KLUANE DISTRICT.

The Kluane placers, including Sheep, Ruby, Burwash and Fourth of July creeks, were worked to about the same extent as last year, producing about \$20,000 and employing about 25 men. During last winter a hill channel has been found on Burwash Creek which is said to prospect very well and from which it is expected good results will be obtained during the coming summer. For quantity and value of placer deposits yet unworked in this district see Table D.

The Kluane and White river copper areas were simply represented during the past year. Until this district is served by a railway it will be impossible to do more than prospect the copper areas.

For collections made in the Kluane office during 1908-9 see Table No. 7. This table is incomplete, as February and March, 1909, have not yet been received from the recorder for the above district; when the above returns are received a statement will be forwarded to you at once as to the amounts collected for the above months.

I also beg to inclose tables showing the distances between points in the southern Yukon and freight rates between principal points, see Tables 3 and 4.

The tables inclosed are—

- No. 1. Quartz claims in good standing, &c.
- No. 2. General information respecting quartz mines.
- No. 3. Table of distances.
- No. 4. Table of freight rates.
- No. 5. Collections in Whitehorse office.
- No. 6. Collections in Conrad office.
- No. 7. Collections in Kluane office.
- No. D. Respecting values of unworked placer deposits.
- No. E. Respecting ore deposits.

Your obedient servant,

R. C. MILLER,  
*Assistant Gold Commissioner.*

TABLE No. 1.

STATEMENT showing Number of Quartz Claims in Good Standing in Whitehorse, Conrad and White River Districts, also Number of Claims Crown Granted in each of above Districts.

| Districts.       | Total Claims under lease. | Number of Locations 1908-9. | Number of Renewals, 1908-9. | Claims Crown Granted. |
|------------------|---------------------------|-----------------------------|-----------------------------|-----------------------|
| Whitehorse ..... | 275                       | 97                          | 178                         | 42                    |
| Conrad.....      | 285                       | 70                          | 201                         | 14                    |
| White River..... | 44                        | 31                          | 13                          | .....                 |

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TABLE No. 2.  
GENERAL INFORMATION RESPECTING QUARTZ MINES.

| Claim.                      | Owners.                                 | Date record. | Ore shipped. |       | Ore on dump. | Cost transportation. | Men employed 1908-9. | Men employed 1909-10. | P. C. value of ore.                                     | Machinery.  | Work completed during 1906-9 and prior to then. | Work contemplated 1909-10. |
|-----------------------------|---|--------------|--------------|-------|--------------|----------------------|----------------------|-----------------------|---|---|---|----------------------------|
|                             |   |              | Tons.        | Tons. |              |                      |                      |                       |   |   |   |                            |
| Anacosta and Rabbit's Foot. | Dickson, Puckett & Whitney.....         | July 11, '99 | 20           | 350   | 10 00        | none                 | .....                | 7                     | none.   | 1907, shafts 60 ft., stripping 750 ft., drift 25 ft.; 1907-2, tunnel 400 ft..                               |   |                            |
| War Eagle and Lerol.....    | Lucas & Kessler.                        | " " 9, '03   | 250          | 250   | 11 00        | 6                    | 6                    | 6                     | none.   | 1907-9, shaft 86 ft., tunnel 155 ft., open cut 100 ft.; prior to 1907 shaft 35 ft.....                      |   |                            |
| Pueblo.....                 | Yukon Pueblo Mines.                     | July 17, '99 | 1,400        | 3,000 | 12 00        | 6                    | 6                    | 5                     | none.   | 1907-8, tunnel 250 ft., 3,000 tons ore quarried; 1899-1901, shaft 100 ft., drift 60 ft.                     | 6 men developing.                               |                            |
| Copper King.....            | Whitney, Melhoyre & Grammer estate..... | Aug. 20, '98 | 1,000        | 100   | 10 00        | 15                   | 6                    | 10                    | \$15,000 60 h.p. boiler, 3 drill comp., 15 h.p. engine. | 1968, 500 ft. tunnels and drifts; 1907, 100 ft. shaft; prior to 1907, shaft 153 ft., drifts 600 ft.....     | 15 men sinking and developing.                  |                            |
| Carlisle.....               | Yukon Pueblo Mines.                     | July 6, '99  | 100          | 50    | 10 00        | none                 | .....                | 22                    | none.   | 1906-7, shaft 50 ft.; prior to 1906, shaft 50 ft. and 50 ft. drift.   |   |                            |
| Spring Creek.....           | Mrs. H. G. Dickson.                     | Aug. 11, '05 | 10           | 100   | 10 00        | none                 | .....                | 10                    | none.   | 1907, shaft 40 feet, drift 20 ft.   |   |                            |
| Empress of India.           | Kate Ryan.....                          | July 8, '99  | 6            | nil   | 10 00        | none                 | .....                | 10                    | none.   | 1907-8, drift 150 ft.   |   |                            |
| Best Chance.....            | Arctic Chief Mining Co.....             | July 25, '00 | 14           | 100   | 8 00         | none                 | .....                | 20                    | none.   | 1907-8, shaft 25 ft., drift 50 ft.; prior to 1907 a number of shallow holes and open cuts.                  |   |                            |
| Grafter.....                | Whitney, Lowe & E. A. Dixon.            | Aug. 17, '99 | 2,200        | nil   | 8 00         | none                 | .....                | 6                     | \$1,000 5 h.p. hoist, 25 h.p. boiler.                   | 1907, shaft 50 ft., stopped 2,000 tons ore; prior to 1907, shaft 50 ft. and 100 ft. drifts.                 |   |                            |
| Arctic Chief.....           | Arctic Chief Co.                        | July 17, '99 | 650          | 600   | 8 00         | 12                   | .....                | 6                     | none.   | 1907-8, tunnel 700 ft., winze 50 ft., stopped 500 tons; prior to 1907, tunnel 300 ft.; 1908, upraise 60 ft. |   |                            |
| Corvette.....               | Baxter, Whitney & Nicholson.....        | Sept. 9, '99 | nil          | 100   | 8 00         | none                 | .....                | 5                     | none.   | 1907, tunnel 30 ft.; prior to 1907, shaft 60 ft. and drift 100 ft.  |   |                            |
| Valerie.....                | A. B. Palmer.....                       | Aug. 23, '96 | 29           | 300   | 8 00         | 6                    | .....                | 5                     | \$1,000 10 h.p. hoist, 16 h.p. boiler.                  | 1908, shaft 50 ft., drifts 200 ft.; prior to 1908, shaft 50 ft., shaft 22 ft.                               |   |                            |
| Gold Hill.....              | J. H. Conrad.....                       | July 7, '06  | 1            | 50    | 20 00        | 4                    | .....                | \$1500                | none.   | 1908, tunnel 50 ft.; 1907, tunnels 100 ft.  |   |                            |

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|                               |  |      |         |     |       |       |     |       |      |  |   |
|-------------------------------|--|------|---------|-----|-------|-------|-----|-------|------|--|---|
| Legal Tender...               | Mrs. L. Hill....                       | "    | 24, '06 | nil | 200   | 20 00 | 4   | ..... | 35   | none.  | 1908, tunnel 87 ft.; 1907, surface work.                                |
| Golden Slipper...             | Geo. Stevens....                       | Aug. | 2, '06  | nil | 25    | 20 00 | 6   | 1     | 60   | none.  | 1908, tunnel and drift 80 ft.   |
| Silver King.....              | Jno. McDonald.                         | "    | 5, '06  | nil | 50    | 20 00 | 5   | ..... | 50   | none.  | 1908, shaft 50 ft.  |
| Tally-Ho.....                 | C. Irving, <i>et al.</i>               | "    | '06     | 50  | 100   | 20 00 | 5   | ..... | 80   | none.  | 1908, tunnel 300 ft.  |
| Venus-Mars                    | Yukon District                         |      |         |     |       |       |     |       |      |  |   |
| Venus No. 2—                  | Gold Mining                            |      |         |     |       |       |     |       |      |  |   |
| Vault.....                    | Co.....                                |      |         | 800 | 2,000 | 16 00 | 45  | ..... | 93.3 | gas engines, 3 hoists, 1 air compressor with 10 drills, aerial tram, and concentrating mill; total value \$80,000. | Shafts and upraises 1,145 feet, tunnels, drifts and crosscuts 1,760 ft. |
| Vault.....                    | Yukon District Gold Mining Co.....     |      |         |     |       | 16 00 | 6   | ..... | 60   | none.  | Tunnels and drifts 590 ft.....  |
| M. & M. Ibex...               | Yukon District Gold Mining Co, Conrad. |      |         | 3   | 50    | 18 00 | nil | ..... | 227  | none.  | Tunnels 134 ft., upraises 40 ft.  |
| Dalton-Annex & Black Fox..... | Bristol, Singer & Vance.....           |      |         | 0   | 0     | 18 00 | 0   | ..... | 40   | none.  | Tunnel 50 feet.   |

None unless better transportation rates are secured; 180,000 tons ore in sight worth \$20 per ton.

None under present cost of transportation. \$35,000 tram if rates are improved.

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TABLE No. 2.—Continued.

| Claim.                        | Owners.                             | Date Record. | Ore Shipped. | Ore on Dump. | Cost Transportation. | Men Employed 1908-9. | Men Employed 1909-10. | Value of Ore Shipped. | Machinery.  | Work done on Claim.   | Ore in Sight. | Work Projected for 1909-10.  |
|-------------------------------|-------------------------------------|--------------|--------------|--------------|----------------------|----------------------|-----------------------|-----------------------|---|---|---------------|--|
|                               |                                     |              |              |              | % c.                 |                      |                       | % c.                  |   |   |               |  |
| Uranus, Capella, Uranus No. 2 | Yukon District Gold Mining Company. | .....        | 3            |              | 20 00                | 0                    |                       | 84 00                 | None  | Drift 300 feet, crosscut 250 feet.  | .....         | To connect mine with mill at Venus by tram.                        |
| Caribon Group.                | Conrad, McKenzie (Grace, Bristol.   | .....        | 100          |              | 15 50                | 12                   |                       | 52 00                 | 1 gas hoist, value \$600.00                                       | Shafts 98 feet and 137 feet, drifts 190 feet and 122 feet.  | .....         | Five mile tram \$100,000; mill \$75,000.                           |
| Montana Group.                | J. H. Conrad <i>et al.</i>          | .....        | 2            |              | 14 00                | 0                    |                       | 97 00                 | 1 aerial tram, 1 gas hoist and 1 engine and air drills \$102,000. | Shafts 53, 24 and 312 feet, winzes 78 feet, upraise 112 feet, drifts 40, 30, 80, 42, and 42 feet. | .....         | Will be mined by large force if rates to smelter are satisfactory. |
| Thistle Group.                | Conrad & Bristol.                   | .....        | 0            |              | 17 00                | 0                    |                       | 50 00                 | None  | Shaft 52 feet.  | .....         |  |

NOTE.—Values given are in \$ per ton; where only a few tons have been shipped the value cannot be accepted as the mine run as the shipments have been carefully hand picked.

Until recently a \$5.00 ore rate prevailed but this rate has been increased to \$13.50 (from Carcross to smelter). This increase in rate will probably close down all the Conrad Mines. No property in the Southern Yukon can ship their mine run under the present rates. Unless the old rate is restored it is almost certain that the work done during the coming year will be nil.







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TABLE D.—VALUE OF UNWORKED PLACER DEPOSITS.

| Name of Creek.              | No. Claims Held. | No. Men Employed. | Surface Pay Gravel (in cubic yards). | Value per Cubic Yd. | Creek Channel Gravel (in cubic yards). | Value per Cubic Yd. | Hill Channel Gravel (in cubic yards). | Value per Cubic Yd. | Unprospected Gravel (in cubic yards). | Total Pay Gravel (in cubic yards). | Average Value per Yd. | Size and Quantity of Available Timber.  |
|-----------------------------|------------------|-------------------|--------------------------------------|---------------------|--|---------------------|---------------------------------------|---------------------|---------------------------------------|------------------------------------|-----------------------|---|
|                             |                  |                   | \$ c.                                | \$ c.               | \$ c.                                  | \$ c.               | \$ c.                                 | \$ c.               | \$ c.                                 | \$ c.                              | \$ c.                 |   |
| <i>Big Salmon Division.</i> |                  |                   |                                      |                     |  |                     |                                       |                     |                                       |                                    |                       |   |
| Livingstone.....            | 53               | 45                | nil.                                 | 4 00                | 12,000                                 | 4 00                | 4,000                                 | 5 00                | 100,000                               | 16,000                             | 4 50                  | Enough wood and saw-logs for use of camp are available in Big Salmon District.                            |
| Cottonova.....              | 18               | 6                 | nil.                                 | 3 00                | 10,000                                 | 3 00                | Unprospected.                         | .....               | 290,000                               | 10,000                             | 3 00                  |   |
| Summit.....                 | 15               | 5                 | nil.                                 | 4 00                | 10,000                                 | 4 00                | "                                     | .....               | 50,000                                | 10,000                             | 4 00                  |   |
| Little Violet.....          | 5                | 5                 | nil.                                 | 4 00                | 10,000                                 | 4 00                | "                                     | .....               | 50,000                                | 10,000                             | 4 00                  |   |
| Mendoema.....               | 2                | .....             | nil.                                 | 2 50                | ?                                      | 2 50                | "                                     | .....               | 500,000                               | .....                              | .....                 |   |
| <i>Kluane Division.</i>     |                  |                   |                                      |                     |  |                     |                                       |                     |                                       |                                    |                       |   |
| Bullion.....                | 20               | 4                 | 10,000                               | 1 00                | nil.                                   | nil.                | "                                     | .....               | 1,000,000                             | 10,000                             | 1 00                  | Limited quantity of fuel and saw-logs available for Sheep and Bullion, 3 to 5 miles from working claims.  |
| Sheep.....                  | 35               | 10                | 150,000                              | 1 00                | nil.                                   | nil.                | "                                     | .....               | 500,000                               | 150,000                            | 1 00                  | Coal used for fuel on Sheep.  |
| Fourth of July.....         | 30               | 15                | 50,000                               | 1 00                | ?                                      | 2 50                | "                                     | .....               | 500,000                               | 50,000                             | 1 00                  | Plenty fuel and limited quantity logs on  |
| Ruby.....                   | 10               | 5                 | 10,000                               | 1 00                | Unprospected.                          | .....               | "                                     | .....               | 100,000                               | 10,000                             | 1 00                  | Fourth of July and Ruby Creeks.   |
| Barwash.....                | 80               | 30                | 100,000                              | 1 00                | 6,000                                  | 7 50                | 10,000                                | 7 50                | 1,000,000                             | 16,000                             | 7 50                  | Very limited quantity fuel or logs near workings on Barwash but plenty below Canyon, available in winter. |

TABLE E.—CONCERNING ORE BODIES.

| Claim.                  | Width of Ore body. | Strike.                               | Dip.                       | Ore in Sight.      | Estimated value per Ton. | Principal Metal.      | Added Values for. |
|-------------------------|--------------------|---------------------------------------|----------------------------|--------------------|--------------------------|-----------------------|-------------------|
| White-horse Belt.....   | 1 to 200 feet..... | N 20° E to 50° N W to<br>N 50° E..... | 50° N W to<br>70° N W..... | 1,200,000 tons.... | \$ 11.00 (copper at 12½) | Copper<br>Silver..... | Gold.             |
| Watson and Wheaton..... | .....              | N 45° W.....                          | .....                      | .....              | 25,000.....              | .....                 | "                 |
| Venus.....              | 3 to 20 feet.....  | N & S.....                            | 45° S.....                 | 180,000.....       | .....                    | .....                 | "                 |
| Vault.....              | 1 to 6 feet.....   | N & S.....                            | 30° W.....                 | .....              | 22,000.....              | .....                 | "                 |
| M & M.....              | 2 feet.....        | N 45° E.....                          | 22° N W.....               | .....              | 150,000.....             | .....                 | "                 |
| Uranus.....             | 3 to 20 feet.....  | N & S.....                            | 14° W.....                 | .....              | 50,000.....              | .....                 | "                 |
| Caribou.....            | 16 feet.....       | E & W.....                            | 12° N to 40°<br>N.....     | .....              | 50,000.....              | .....                 | "                 |
| Montana.....            | 3 to 7 feet.....   | N & S.....                            | 25° W.....                 | .....              | 20,000 (?).....          | .....                 | "                 |
| Thistle.....            | 2 to 3½ feet.....  | N & S.....                            | 25° W.....                 | .....              | 100,000.....             | .....                 | "                 |

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TABLE No. 5.—STATEMENT showing the Collections Made in the Office of the Asst. Gold

| Month.                          | MINING DUES. |                   |                |                                    |         |                             |                     |                          |                                    |                            |
|---------------------------------|--------------|-------------------|----------------|------------------------------------|---------|-----------------------------|---------------------|--------------------------|------------------------------------|----------------------------|
|                                 | PLACER.      |                   |                |                                    | QUARTZ. |                             |                     |                          |                                    |                            |
|                                 | Grants.      | Reloca-<br>tions. | Renew-<br>als. | Registration<br>of Docu-<br>ments. | Grants. | Certificate-<br>of<br>Work. | Payment in<br>Lieu. | Certificated<br>Payment. | Registration<br>of Docu-<br>ments. | Average and<br>Cr'n Grant. |
| 1908.                           | % cts.       | % cts.            | % cts.         | % cts.                             | % cts.  | % cts.                      | % cts.              | % cts.                   | % cts.                             | % cts.                     |
| April.....                      | 130 00       | 10 00             | .....          | 37 00                              | 140 00  | 20 00                       | 100 00              | .....                    | 15 50                              | .....                      |
| May.....                        | .....        | 60 00             | 42 00          | 7 00                               | 30 00   | 57 50                       | .....               | 5 00                     | 9 50                               | .....                      |
| June.....                       | .....        | 20 00             | 15 00          | 28 00                              | 110 00  | 60 00                       | .....               | 12 50                    | 10 00                              | .....                      |
| July.....                       | 70 00        | 50 00             | 275 00         | 99 00                              | 35 00   | 45 00                       | 300 00              | 5 00                     | 55 00                              | 189 48                     |
| August.....                     | .....        | .....             | 10 00          | 10 00                              | 20 00   | 67 50                       | .....               | 5 00                     | 50 00                              | .....                      |
| September.....                  | .....        | .....             | 300 00         | 26 00                              | 30 00   | 62 50                       | .....               | .....                    | 7 50                               | .....                      |
| October.....                    | .....        | 20 00             | 150 00         | 43 00                              | 20 00   | 32 50                       | .....               | 5 00                     | 7 50                               | 160 95                     |
| November.....                   | .....        | .....             | .....          | 8 00                               | 20 00   | 17 50                       | .....               | 5 00                     | 7 50                               | 124 31                     |
| December.....                   | .....        | 30 00             | 120 00         | 4 00                               | 25 00   | 22 50                       | .....               | .....                    | 17 50                              | 73 50                      |
| 1909.                           | .....        | .....             | .....          | .....                              | .....   | .....                       | .....               | .....                    | .....                              | .....                      |
| January.....                    | .....        | .....             | .....          | 12 00                              | 20 00   | 17 50                       | .....               | 2 50                     | 17 50                              | 228 52                     |
| February.....                   | .....        | 20 00             | .....          | .....                              | 105 00  | 27 50                       | .....               | .....                    | 35 00                              | .....                      |
| March.....                      | .....        | .....             | 60 00          | .....                              | 5 00    | 7 50                        | .....               | .....                    | .....                              | .....                      |
| Total.....                      | 200 00       | 210 00            | 972 00         | 274 00                             | 560 00  | 437 50                      | 400 00              | 30 00                    | 252 50                             | 776 78                     |
| Number of re-<br>ceipts issued. | 20           | 21                | 61             | 64                                 | 97      | 174                         | 4                   | 12                       | 88                                 | 36                         |

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## Commissioner and Crown Timber and Land Agent During the Fiscal Year 1908-9.

| Dominion<br>Lands<br>Receipts. | TIMBER AND LAND DUES. |          |         | EXPORT TAX.     |          |         | TOTAL FOR MONTH FOR |           |
|--------------------------------|-----------------------|----------|---------|-----------------|----------|---------|---------------------|-----------|
|                                | Timber.               | Seizure. | Coal.   | Home-<br>stead. | Royalty. | Free.   | 1908-9.             | 1907-8.   |
| \$ cts.                        | \$ cts.               | \$ cts.  | \$ cts. | \$ cts.         | \$ cts.  | \$ cts. | \$ cts.             | \$ cts.   |
| 221 77                         |                       |          |         |                 |          |         | 674 27              | 4,100 88  |
| 3,365 08                       | 137 50                | 1,000 00 | 15 00   |                 | 24 38    |         | 4,752 90            | 1,132 00  |
| 277 77                         | 55 00                 |          |         |                 | 259 21   |         | 837 48              | 1,660 34  |
| 176 51                         |                       |          |         |                 | 152 80   |         | 1,452 79            | 1,276 48  |
| 264 90                         |                       |          |         | 10 00           | 511 04   |         | 948 44              | 1,246 15  |
| 472 91                         | 200 00                | 1,000 00 |         |                 | 112 03   | 1 00    | 2,271 94            | 1,152 19  |
| 657 54                         | 251 25                |          |         |                 | 579 14   |         | 1,917 88            | 1,790 51  |
| 163 62                         | 282 50                |          |         |                 | 45 40    |         | 673 89              | 509 50    |
| 149 65                         | 335 00                | 1,000 00 |         |                 | 50       |         | 1,777 67            | 608 10    |
|                                |                       |          |         |                 |          |         | 298 02              | 215 81    |
| 158 18                         | 260 00                |          |         |                 | 39 80    |         | 665 48              | 558 00    |
| 285 88                         | 255 00                |          |         |                 |          |         | 613 38              | 853 25    |
| 6,193 81                       | 1,836 25              | 3,000 00 | 15 00   | 10 00           | 1,715 30 | 1 00    | 16,884 14           | 15,109 71 |
| 48                             | 16                    | 3        | 3       | 1               | 49       | 1       | 698                 |           |

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TABLE NO. 6.—STATEMENT showing the Collections made in the Office of the Mining Recorder for the Conrad District during the Year 1908-9.

|                   | QUARTZ MINING DUES. |                            |  |                        |   |                            | Total for<br>1908-9. | Total for<br>1907-8. |
|-------------------|---------------------|----------------------------|--|------------------------|---|----------------------------|----------------------|----------------------|
|                   | Grants.             | Certificate<br>of<br>Work. | Certificate<br>of<br>Part-<br>nership. | Payment<br>in<br>Lieu. | Registra-<br>tion of<br>Docu-<br>ments. | Acreage<br>Crown<br>Grant. |                      |                      |
| 1908.             | \$ cts.             | \$ cts.                    | \$ cts.                                | \$ cts.                | \$ cts.                                 | \$ cts.                    | \$ cts.              | \$ cts.              |
| April.....        | 10 00               | 12 50                      | 5 00                                   |                        | 26 00                                   |                            | 53 50                | 30 00                |
| May.....          | 5 00                | 7 50                       |  | 100 00                 | 2 50                                    |                            | 115 00               | 47 50                |
| June.....         | 30 00               | 57 50                      | 22 50                                  | 200 00                 | 17 00                                   |                            | 327 00               | 321 00               |
| July.....         | 60 00               | 235 00                     | 5 00                                   |                        | 60 00                                   |                            | 360 00               | 336 00               |
| August.....       | 75 00               | 187 50                     |  | 900 00                 | 30 00                                   | 242 88                     | 1,435 38             | 884 50               |
| September.....    | 115 00              | 45 00                      |  | 200 00                 | 32 50                                   |                            | 392 50               | 255 00               |
| October.....      | 50 00               |                            |  |                        | 62 50                                   | 848 58                     | 961 08               | 55 00                |
| November.....     | 5 00                | 20 00                      |  |                        | 30 00                                   |                            | 55 00                | 41 50                |
| December.....     |                     | 5 00                       |  |                        | 2 50                                    |                            | 7 50                 | 18 00                |
| 1909.             |                     |                            |  |                        |   |                            |                      |                      |
| January.....      |                     | 5 00                       |  |                        | 5 00                                    |                            | 10 00                | 104 50               |
| February.....     |                     |                            |  |                        | 15 00                                   | 56 65                      | 71 65                | 22 50                |
| March.....        |                     | 12 50                      |  |                        | 35 00                                   |                            | 47 50                | 202 50               |
| Total.....        | 350 00              | 587 50                     | 32 50                                  | 1,400 00               | 318 00                                  | 1,148 11                   | 3,836 11             | 2,319 00             |
| No. receipts..... | 70                  | 201                        | 13                                     | 14                     | 73                                      | 54                         | 425                  | .....                |

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TABLE No. 7. —STATEMENT showing the Collections made in the Office of the Mining Recorder for the Klwane District during 1908-9.

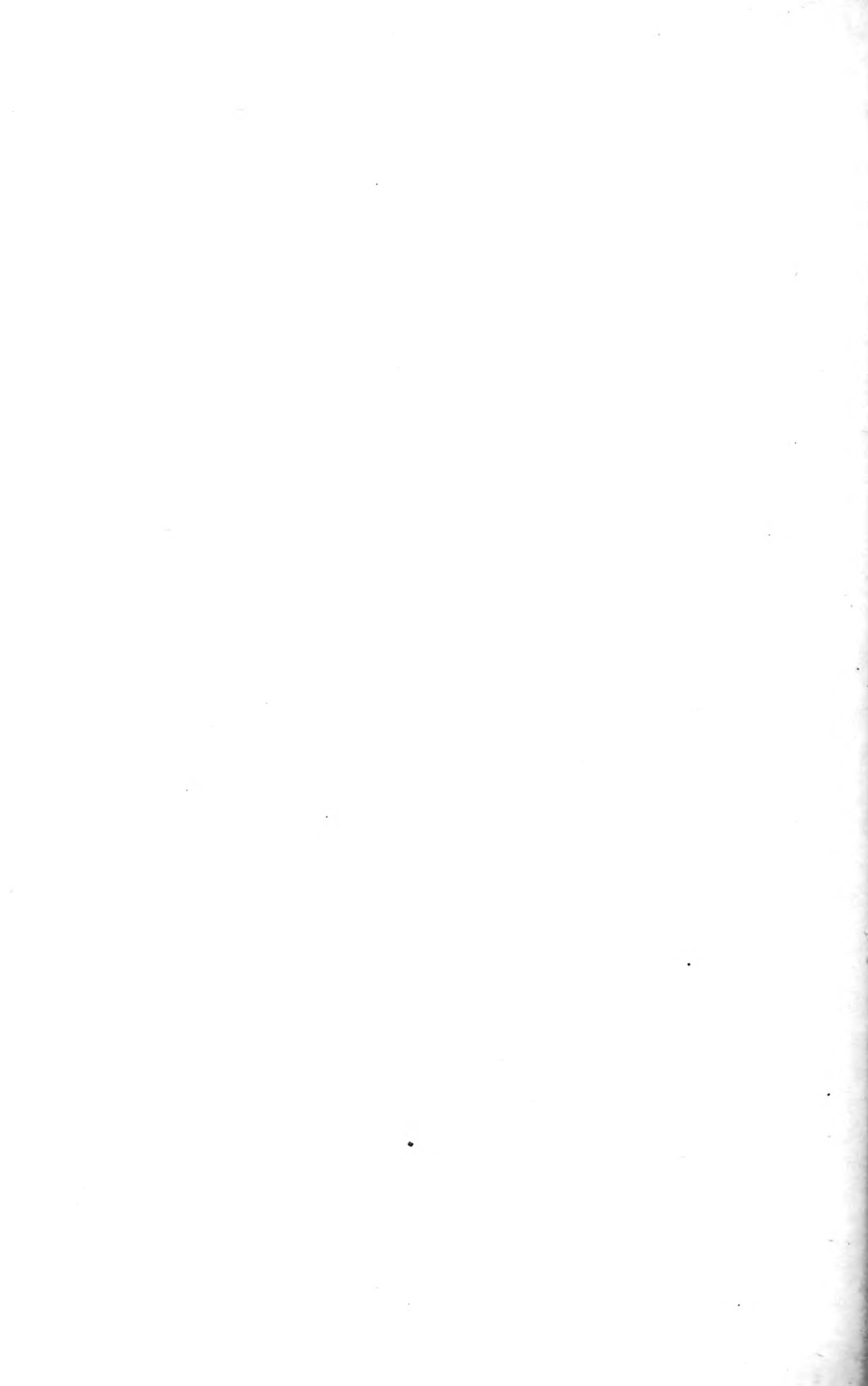
|           | PLACER MINING DUES. |               |           |   | QUARTZ MINING DUES. |                            |                                   |                        | Total for 1908 9. | Total for 1907 8. |   |
|-----------|---------------------|---------------|-----------|---|---------------------|----------------------------|-----------------------------------|------------------------|-------------------|-------------------|---|
|           | Grants.             | Re-locations. | Renewals. | Registra-<br>tion of<br>Docu-<br>ments. | Grants.             | Certificate<br>of<br>Work. | Certificate<br>of<br>Partnership. | Payment<br>in<br>Lieu. |                   |                   | Registra-<br>tion of<br>Docu-<br>ments. |
|           |                     |               |           |   |                     |                            |                                   |                        |                   |                   |   |
| 1908.     |                     |               |           |   |                     |                            |                                   |                        |                   |                   |   |
| April     |                     | 20 00         | 15 00     | 30 00                                   |                     |                            |                                   |                        |                   | 65 00             | 828 00                                  |
| May       |                     | 30 00         | 330 00    | 6 00                                    |                     |                            |                                   |                        |                   | 6 00              | 80 00                                   |
| June      |                     | 40 00         | 93 00     | 4 00                                    | 50 00               |                            |                                   |                        |                   | 422 00            | 1,102 50                                |
| July      | 20 00               | 80 00         | 125 00    | 32 00                                   | 7 50                |                            |                                   |                        |                   | 144 50            | 100 00                                  |
| August    | 70 00               |               | 335 00    | 30 00                                   | 7 50                |                            |                                   |                        |                   | 257 00            | 292 00                                  |
| September | 140 00              |               | 120 00    | 26 00                                   | 5 00                |                            |                                   |                        | 5 00              | 452 50            | 392 50                                  |
| October   | 30 00               |               | 30 00     | 4 00                                    | 10 00               |                            |                                   |                        |                   | 296 00            | 124 00                                  |
| November  |                     | 90 00         | 15 00     |   | 30 00               |                            |                                   |                        |                   | 94 00             | 291 50                                  |
| December  |                     |               |           |   | 235 00              |                            |                                   |                        |                   | 200 00            | 77 50                                   |
| 1909.     |                     |               |           |   |                     |                            |                                   |                        |                   |                   |   |
| January   |                     |               |           |   |                     |                            |                                   |                        |                   | 20 00             | 2 50                                    |
| February  |                     |               |           |   |                     |                            |                                   |                        |                   |                   | 81 00                                   |
| March     |                     |               |           |   |                     |                            |                                   |                        |                   |                   | 77 00                                   |
| Total     | 260 00              | 260 00        | 1,063 00  | 144 00                                  | 240 00              | 295 00                     | 200 00                            | 240 00                 | 32 50             | 2,494 50          | 3,338 50                                |





PART VII

FORESTRY AND IRRIGATION



# FORESTRY AND IRRIGATION.

## REPORT OF THE SUPERINTENDENT OF FORESTRY AND IRRIGATION.

DEPARTMENT OF THE INTERIOR,  
FORESTRY BRANCH,

OTTAWA, May 25, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR.—I have the honour to submit the report of the work of the Forestry and Irrigation Branch for the year 1908-9 and also the reports of the officials in charge of the different divisions of the work.

### ORGANIZATION.

The only addition to the technical staff of the Forestry Branch during the year was made in the Tree Planting Division by the addition of Jas. Kay and Jas. N. B. McDonald to the staff of inspectors.

The hydrographic survey was given a separate organization with Mr. P. M. Sauder in charge. Mr. Sauder has had charge of one of the parties making inspections under the Irrigation Act and conducting stream measurements during several years and has shown himself competent.

Mr. H. R. Carscallen and Mr. H. C. Ritchie have been appointed assistants for the hydrographic survey.

Mr. J. S. Tempest was appointed to take charge of the inspection work formerly done by Mr. Sauder.

The death of Mr. R. S. Cook, Crown timber agent at Prince Albert, is greatly to be regretted and will be a decided loss to the forest service, as he took a great interest in the protection of the forests and the adoption of improved methods of administration. It was on his suggestion that the fire patrol was extended to Churchill river last year and that an effort is being made to enlist the interest of the Indians.

An important change in administration has been made by providing for the handling at the office at Indian Head of all applications for trees for planting. Formerly all such applications were received at the head office at Ottawa and dealt with here. It was felt that it would be an economy of time to have the applications sent to Indian Head, and that the inspectors who visited the different districts would be best qualified to deal with these applications and to give any necessary explanations in special cases. An office for this purpose has therefore been organized at Indian Head and it is hoped that it will increase the promptness and efficiency of the service.

The work of the Forest Service of the United States is spoken of in the highest terms of praise and with good reason, but it may be pointed out that, although the extent of Canada is not less than that of the United States, the forest service of the latter has an appropriation of \$4,640,000 and a permanent staff of over 2,000, while the Canadian forest service has an appropriation of \$100,000 and a permanent staff of about forty. If the Canadian people wish a service equally efficient with that of the United States they must be prepared to deal much more generously with it than they now do.

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In May of last year I accompanied Dr. W. F. King to Washington in connection with the discussion of the terms of agreement for the division of the waters of St. Mary and Milk rivers between the United States and Canada, and also accompanied Mr. Geo. C. Gibbons to Washington for a similar purpose in December.

During the summer I visited the various districts of the West where the work under charge of this branch is located and consulted with the officers in charge. I also attended the Second Canadian Irrigation Convention held at Vernon in August. The discussions at the convention were very interesting, but related mainly to the administration of irrigation in British Columbia and a proposed revision of the Act governing the subject in the province.

In December I accompanied Hon. W. C. Edwards to the meeting of the Internal Harbours and Waterways Convention and also the Conservation Convention held at Washington.

#### STATISTICS.

Mr. A. H. D. Ross, lecturer at the forest school of the University of Toronto, was appointed during last summer to collect such statistics as were available in regard to the forests and the timber production of Canada, and the result of his investigations is being published. The reliable information was found to be so small as to leave all calculations incomplete and indefinite. The forest area may, however, be put at between 500 and 600 million acres with a stand of about as many billion feet, but neither these nor any other figures available are entitled to any great reliability in the present state of knowledge of the forests of Canada. The production of timber in Canada in 1900, according to the last census, was about nine billion feet board measure. This quantity has probably increased, but there are no later figures to determine the matter. The conclusions reached in regard to the whole matter were as follows:—

1. In order to have reliable information in regard to the forest resources of Canada it is necessary that forest surveys should be begun and systematically carried out by the Dominion and provincial governments on the forest lands under their control, respectively.

2. Statistics in regard to the production of timber in Canada should be collected annually by the Forestry Branch in conjunction with the Census Bureau and published for the information of the public.

3. Official returns in regard to timber production should give more detailed information in regard to species.

In accordance with the second suggestion steps have been taken towards compiling a list of names of firms using wood products throughout Canada, and circulars asking for the desired information have been sent out to all parts of the Dominion. It will take several years to get the lists fully completed and to have the purposes of the inquiry so understood that information will be given willingly and without reservation. The results will, however, be published from year to year, whether at first they can be made complete or not.

#### FOREST SURVEYS.

Forest surveys are of different characters. The simplest is the exploratory survey. Such a survey is required for the whole of the northern forested districts. The fact may be again emphasized that there is a large tract of land more or less forested stretching from Hudson bay to the Rocky mountains, a distance of 1,000 miles, and having a general depth of 400 miles, which is under Dominion administration, and that the forest on this tract is of great value for local consumption. It has already suffered greatly from fire and the timbered areas that remain should be carefully protected. In order to do so effectively and economically more definite

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information is necessary as to their location and this would be obtained by an exploratory survey. All of this tract has been travelled along certain lines by members of the Geological Survey staff and other explorers, but their travels have followed canoe routes and fixed lines of travel, and large areas are still left uninspected.

The province of Ontario explored its northern forest area of sixty million acres in 1899 at a cost of \$40,000. A similar exploration of the northern forested area under Dominion control, which comprises about five times the extent of territory, could be made on similar lines for \$200,000, or \$20,000 for ten years. Such an exploratory survey is not beyond the resources of the Dominion and is absolutely necessary for an intelligent management of this extensive district.

Following the exploratory survey and the location of the timbered lands and non-agricultural areas, a more careful examination of the timber would be made by reconnaissance survey as it became necessary, as is now being done on the forest reserves. Such a survey gives information as to the species, the stand and the condition of the timber, the topography, and matters generally that affect the management of the forest and the handling of the timber.

Timber surveys on the forest reserves were continued during the past year, and about one million and a quarter acres of the ten million in forest reserves and parks have now been surveyed. The results show that the reserves, so far as the survey has extended, are in poor condition, the result of fire and careless cutting, and a long course of careful management will be required before they are brought into proper forest condition again. The survey is the first step toward that end. Having a knowledge of the condition and location of the forest stands, their accessibility, the possibility of their utilization, and the extent to which natural reproduction is providing for the replacement of the stand, it is possible to pursue an intelligent plan in the handling of the timber and the administration of the reserve.

Plans for the management of the reserves which have been surveyed will be prepared and it is hoped that, with proper protection and management, they will in time be brought into good producing condition again. But the process will be slow and will take many years to accomplish. The records of growth of white spruce, for instance, on the Riding Mountain reserve, which may be taken as a reasonable average, show that it has taken 75 years for trees of this species to reach a diameter of ten inches. The sooner, therefore, that the process of reproduction can be begun the better.

The surveys of the forest reserves should be continued systematically until the whole area has been covered.

## FOREST RESERVES.

The survey of the Riding Mountain Forest reserve was continued under charge of Mr. J. R. Dickson and was practically completed. A full report of the results of the survey of this reserve, and a map showing the location of the timber have been prepared and published separately. Of a total area of 982,400 acres in this reserve, only 221,319 acres are described as timbered. The timber of over eight inches in diameter at breast height is 210,740,346 feet board measure, and of this poplar forms 54 per cent and white spruce only 20 per cent. There are only a little over 42 million feet board measure of white spruce. This reserve is one of those on which there is the greatest demand for timber and wood and every effort will be made to assist reforestation. Unfortunately the natural reproduction of white spruce, the most valuable tree, is not good, and it will be necessary to resort to sowing or planting if this species is to be reproduced as it should be.

The protection of the timber and the administration of the reserve will be facilitated by the removal of a number of squatters who had located on this reserve. These, to the number of 126, were induced to remove from the reserve, and that this was

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accomplished successfully without serious friction and leaving these people on the whole well satisfied, as many of them have attested by statements over their own signatures, reflects great credit on the inspector and forest rangers who carried out this work.

A reconnaissance survey was made of the Pines Forest reserve, a tract of 145 square miles, situated south of the North Saskatchewan river, southwest from Prince Albert. This reserve is mostly light, sandy land, with some muskeg, and was covered with a forest of jackpine, with spruce and tamarack on the lower ground. This tract has furnished a large supply of ties for railway construction; from it lumber was secured to build many of the houses in the neighbourhood, and it has supplied fuel not only to the vicinity but to the towns on the prairie farther to the south. Thirty years ago the reserve was heavily timbered. The contractors twenty years ago left a heavy slash; following this fires from the railroad and settlements swept it clean until now there is not an acre left but is burned over or cut over. Scattered in patches there are 45,000 cords of fuel, 15,000 of which are dead. This supply will not last ten years. This whole tract is unsuited for agriculture, but can produce a good growth of timber, and with adequate protection from fire and reasonable care in cutting, the task would not be difficult as the jackpine produces a good seed supply which germinates readily. On some 23,000 acres there is a good reproduction of young jackpine.

North of the North Saskatchewan river, and running east to a considerable distance beyond Prince Albert, is an extension of the same sandy tract covered with jackpine forest in various stages, some mature, some covered with reproduction of various ages and some recently burned. If this tract is opened to settlement it will mean disappointment to those who attempt to make homes upon it; it will mean the destruction of the forest, which would be of great benefit to Prince Albert and the district both for wood supply and shelter; it will mean a waste of shifting sand useless in itself and a menace to the good land surrounding it, and will in the end require action such as is now being taken by the province of Ontario to buy back and reforest such lands. It would be a desirable policy for the Dominion government and the city of Prince Albert to unite in maintaining this tract as a municipal forest reserve.

The Spruce Woods reserve in Manitoba covers a sandy tract, and as there is a considerable area of land of similar character in the vicinity an inspection was made of it and it is proposed to increase the area in this reserve. An addition has also been proposed, after inspection, to the Beaver Hills Forest reserve.

#### CYPRESS HILLS.

The Cypress Hills form the most important elevation in southwestern Saskatchewan and southeastern Alberta and located, as they are, in a district where the rainfall is frequently deficient and where irrigation is generally practised, the necessity for the preservation of every favourable influence on moisture conditions is apparent. This district will be the home of the small rancher who will assist and ensure his fodder supply by means of irrigation. The greater moisture on the hills is demonstrated by the fact that while, during the dry season of the last year, there was practically no hay crop on the lowlands, the hay on the Cypress Hills was the only supply that saved the situation for many of the ranchers in the vicinity. A small forest reservation of one-half township was made in 1906 and last summer a general examination of the hills was made by Mr. A. Kuechtel, inspector of forest reserves, to determine what further and other lands should be reserved. A considerable addition was recommended and these lands have been temporarily reserved pending a further inspection. There will be no difficulty in covering the greater part of the Cypress Hills with a good growth of lodgepole pine and spruce and the great advantage of a forest on

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these hills in the conditions which exist will more than justify every effort to restore their forest-clad condition and indeed imperatively demands that such action should be taken.

## CROWSNEST PASS.

One of the most interesting investigations made during the past season was that in the Crowsnest district made by Mr. H. R. MacMillan. The eastern slope of the Rocky mountains, the source of the great river systems that water most of the western prairie country, presents one of the most interesting studies to be found in the Dominion. The forests on these great mountain slopes assist in preserving the water supply and form the reservoir for wood and lumber for the province of Alberta, one of the greatest assets for comfort and happiness that any province can have, and, moreover, on it depends largely the development of coal mining in that province, as without timber, coal mining is impossible, and the requirements for the development of the coal mines along the eastern slope of the Rocky mountains will be enormous. It is estimated that there are twenty-two and one-half billion tons of coal to be found in Alberta in the Rocky mountain district. The mining of such a quantity of coal will require 45 billion lineal feet of mining props, the product of nine million acres for sixty years.

In the Crowsnest valley the mines now in operation are using three million lineal feet of mining props and two and one-half million feet board measure of lumber and dimension timber, and in five years more this quantity will probably have doubled, then requiring the product of 66,000 acres. The total area in this valley is 135,680 acres, of which only 21,120 acres are covered by a mature unburned forest, the remainder being entirely denuded, covered with dead standing timber or with young growth. The worst fires occurred fourteen years ago, about the time the railway was built. The loss by fire was probably 570 million feet board measure of lumber worth \$9,000,000. The timber for the future needs of the coal mines of the Crowsnest is not in sight in that valley as a result of this great destruction by fire, and it is necessary that the most careful attention should be given to this district and the whole eastern slope of the Rocky mountains to ensure that the forest cover so absolutely necessary from so many points of view should be preserved.

A more thorough and efficient fire patrol system is required and in order to organize and distribute it as economically as possible, and to administer the forests on an intelligent basis a timber survey and mapping of the whole eastern slope should be made with the least possible delay.

## MINING CLAIMS.

As application had been made for coal lands within certain of the forest reserves, and it was not the intention in the establishment of the reserves that the working of valuable minerals which might be found located therein should be prevented, it was decided to grant mining leases under the Mining Regulations, subject to the following additional restrictions :—

1. No lease for coal mining rights within a forest reserve shall be granted until the application has been reported upon by the superintendent of forestry.
2. No lease for coal mining purposes shall entitle the lessee to purchase the surface rights, but the lessee may, upon application, be granted a lease, concurrent with that for the coal mining rights, for such portion of the surface rights thereof as the Minister of the Interior may consider necessary for the efficient and economical working of the coal mining rights granted under such lease.
3. That the lessee will do no unnecessary damage to timber and will carefully observe all the provisions of all regulations relating to forest reserves.

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4. That no trees on the reserve will be cut by him without the permission of the superintendent of forestry, and that when any trees are cut by him he will carefully clear the ground of all tops and branches and other debris of such cutting, and will so dispose of them as to prevent danger from fire in accordance with the instructions of the officer in charge of the reserve. If in order to so dispose of such debris it is necessary to burn it, the lessee shall give due notice of his intention so to do to the officer in charge of the reserve, and before he proceeds to burn such debris shall obtain the consent of such officer, and shall comply with all the conditions imposed by such officer in regard to such burning.

5. That the lessee shall clear and at all times keep clear of inflammable material a space of at least one hundred feet in width surrounding his works or operations.

6. That any engine operated by the power of steam used by him in connection with his works or operations shall be fitted with efficient spark arresters which shall at all times be kept in a state of good repair.

Similar regulations were established for other classes of mining claims in forest reserves and for such claims within timber limits.

#### SUMMER RESORTS.

A great many people are resorting to the forest reserves for holiday outings during the summer, and it is considered that this is not only a legitimate use of the reserves, but that the presence of such people, wholly in sympathy with the purposes of the reserves, will be a great assistance in case of fire. Regulations for dealing with the use of the reserves for such purposes have been prepared and a copy is attached hereto.

#### FIRE RANGING.

The season of 1908 will be long remembered as one of the dry seasons, and it was only the fortunate absence of high winds that prevented its being one of the most disastrous for forest fires.

Throughout the province of British Columbia the same dry conditions prevailed and unfortunately they were accompanied at times by high winds so that the worst fires chronicled for the Dominion occurred in that province. In the northern forested districts of the prairie provinces fortunately the season was not so dry and there was less danger of fire.

The most serious fires which occurred on Dominion lands were at Salmon arm, Manson creek and White lake, due to fires set by settlers, and the latter partly due to fire from a logging engine used by a lumber company. The loss in these fires was 200,000 feet board measure of timber totally destroyed and 10 million feet damaged. It will be seen from this that the lumber companies are sometimes careless in regard to fire, and the example quoted is not by any means the only one of carelessness on their part. Some firms seem to consider that the government is entirely responsible for the protection of their timber and that they do not need to take any interest in the matter. The other two fires referred to are an example of the result of encouraging encroachment by squatters on timber berths and point to the necessity for a revision of the procedure in this respect and a proper understanding with the licensees in regard to the clearing of lands fit for settlement.

Outside of the loss of timber occasioned by these fires there was a direct expenditure of \$3,122.34 in fighting them.

Another serious fire was that in the valley of the Spray river in the Rocky Mountains Park. It is supposed to have been started by a party of tourists, although it was impossible to get sufficient evidence to establish the fact, and burned about three million feet of timber. A more efficient patrol of the park is being provided for during the coming season.



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The total number of rangers was 82, distributed as follows :—British Columbia, 35; Alberta, 34; Saskatchewan, 13.

The patrol was extended in the northern districts. One ranger was placed north of The Pas, the present terminus of the Hudson Bay Railway. In the country north of Prince Albert a patrol was carried on up to the Churchill river, comprising Lac la Ronge, where considerable mining excitement prevailed, with a consequent influx of prospectors. In addition to the staff on the Athabaska and Lesser Slave rivers, rangers were placed on the Peace and Great Slave rivers, thus reaching the most important routes of travel.

While this might seem to indicate that the patrol of this northern district is well provided for it will be seen on reference to the map accompanying this report that there are large tracts as yet entirely unreachd, while the districts assigned to rangers cover routes of travel as much as two hundred miles in length. It must be realized that the district to be protected stretches from Hudson Bay to the Rocky mountains, a distance of 1,000 miles, with a width from 300 to 600 miles, and that a patrol of 37 men is a mere handful and utterly inadequate to the task to be accomplished. Some of the most important points and routes of travel are entirely unprotected, as for instance, the whole district surrounding and north of lake Winnipeg to Hudson Bay, the whole valley of the Churchill river and a great part of the Peace and Mackenzie river districts. If the forests of this great region, so absolutely necessary to a northern district, a great portion of which is not even provided with coal, are to be preserved, an appropriation sufficient to provide an efficient and comprehensive patrol must be given, and the interests involved would thoroughly justify the expenditure.

A special patrol was maintained during last season along the line of the Grand Trunk Pacific Railway and as a result no serious fire occurred. As provided for by the Forest Reserve Act one-half of the expenditure within five miles of the line of construction was assessed against the railway company and has been paid by it.

The projection of numerous other lines of railway into the northern districts makes it imperative that every possible precaution should be taken to prevent the destruction by fire of such forest as remains. It is unfortunately true that large areas of land in the northern country once well forested with mature timber are now but a waste as a result of fires started by human agencies, of which the railway has been one of the most destructive.

To provide for the proper protection of the forests it will be necessary also to enlist the interest of the Indians. With this purpose in view a fire notice in the Indian syllabic in both Cree and Chipewyan was obtained from some of the northern missionaries and has been printed for distribution. Facsimile of the notice in Cree with a translation in English is appended. Communication was opened with some of the missionaries to the Indians to enlist their sympathy, and it was proposed to have representatives of the department visit the principal meeting places of the Indians during the summer to discuss these questions with them. Owing to an insufficient appropriation it is unlikely that this plan can be carried out.

## TREE PLANTING DIVISION.

The tree planting division is now well established and organized, and as its advantages are understood and appreciated it will require mainly development along the lines already successfully followed to meet the growing needs and increasing population of the prairie provinces.

In the distribution for the spring of 1909, 2,010 applicants were supplied, 2,570,000 trees being provided for this purpose. The new applications received for the distribution of 1910 number 2,235.

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Up to the present time no general distribution of coniferous trees has been made owing to the difficulty of handling and working up a stock. It is hoped, however, to be in a position to begin the distribution of coniferous trees in 1911. The species which will be provided in largest numbers are white spruce, jackpine, lodgepole pine and Scotch pine. The native tamarack is one of the most satisfactory of the coniferous trees and a stock of this species will be developed as soon as possible.

Other varieties of coniferous trees are being tested, including species from Europe and Japan, as well as those from the United States and native species.

## DOMINION PARKS.

The Dominion parks as distinguished from the forest reserves are the following:—

Rocky Mountains Park, located on the eastern slope of the Rocky mountains, along the main line of the Canadian Pacific railway, comprises an area of 2,880,000 acres. It was first set apart by an Act of parliament passed June 23, 1887, and its area was greatly extended by an amending Act dated 1902.

Yoho Park corresponds on the western slope of the Rocky mountains to the Rocky Mountains Park on the eastern slope. It was set apart by Order in Council, dated December 14, 1901, and comprises an area of 530,000 acres.

Glacier Park is the heart of the Selkirk range. It was established by Order in Council of October 11, 1888, and extended by an order, dated November 26, 1903, and comprises an area of 368,640 acres.

Jasper Park corresponds on the line of the Grand Trunk Pacific Railway to Rocky Mountains Park on the line of the Canadian Pacific Railway. It was established by Order in Council of September 14, 1907, and comprises an area of 3,200,000 acres. This park has not yet been organized.

Elk Island Park, lying east of Edmonton, was established July 13, 1906, and comprises an area of 10,240 acres.

Buffalo Park was set apart by Order in Council, dated March 7, 1908, and comprises an area of 101,760 acres. It is located in the eastern part of Alberta in open and bluff country specially suited for a buffalo run.

The changes that have been made in the organization of the Dominion National Parks are the removal of Mr. O. D. Hoar, Superintendent of Yoho Park, and the appointment of Mr. E. Ellis as superintendent of Buffalo Park.

The regulations governing the parks have been consolidated and amended so as to provide for more thorough administration and more complete fire and game protection. Provision was made for the appointment of fire and game guardians, whose duty it will be to see that the regulations are enforced. No person will be allowed to carry firearms in the parks unless they have been properly sealed by the superintendent or other officer, and the licensed guides as well as the game guardians will be responsible for seeing that this regulation is enforced.

The fence surrounding the Buffalo Park was satisfactorily completed. It is a substantial structure, 74 miles long, consisting of fourteen strands and nine feet in height. It is sufficiently strong to be a safe inclosure for the buffalo and the park should form an ideal place for the Canadian herd.

It was expected that the remainder of the buffalo purchased from M. Pablo of Montana would have been brought over last fall, but unfortunately the attempt to corral the herd ended in failure. It is proposed, however, to have this herd brought over during the coming season and the herd at Elk Island Park, with the exception of a small number, will also be transferred to Buffalo Park. The latter herd is reported in good condition, having come through the winter successfully. There is a gratifying increase in number which assures the perpetuation of the stock.

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## ST. LAWRENCE ISLAND PARK RESERVATION.

This reservation consists of eleven islands and a small peninsula on the St. Lawrence river between Brockville and Gananoque. These islands were formerly owned by the Mississagua band of Alhwick, from whom they were purchased and transferred to the Department of Interior by Order in Council in 1904 to be held for public use. Pavilions have been erected on six of these islands and they have been equipped with stoves, tables, benches, &c. The pavilions have recently been repaired and painted and furnished with additional conveniences. This reservation for public use is of great benefit and gives the opportunity for pleasant outings for thousands who would not have had access to the islands if they had been disposed of to private persons.

## IRRIGATION.

During the year just closed there has been a marked decrease in the number of applications for water for irrigation purposes, and an equally notable shrinkage in the number of applicants to purchase land under the irrigation system. This is due, probably, to two main causes: first, the adoption on January 2, 1908, of new regulations which require the actual irrigation of fifty per cent of all lands purchased under the irrigation system, instead of twenty-five per cent as formerly; and second, to the provisions of the amended Dominion Lands Act permitting the acquirement by settlers of land by pre-emption or purchase, in addition to that acquired by homestead entry. A third, and perhaps equally important cause, is the fact that the valleys of the principal streams are now pretty well settled and the available water supply largely appropriated, thus making it necessary to construct larger and more expensive ditches if the remaining available water supply is to be utilized by means of reservoirs and applied to the higher lands adjoining the settled valleys. The cost of such works is usually beyond the means of the average settler.

In so far as irrigation has developed in the so-called semi-arid district, which comprises southern Alberta and southwestern Saskatchewan, the tendency has naturally been to acquire the easily-irrigable lands in the valleys, either by homestead entry or by purchase under the irrigation system, or by both means, and to secure a water right from the nearest stream. As these lands are low and fairly level, irrigation ditches can be built at moderate cost and a fair proportion of the land brought under the ditch. The result has been the settlement of the more desirable valley lands, leaving the equally productive bench lands undeveloped, owing to the higher cost of bringing water to them. Usually each irrigator owns his own system of ditches independently, but there seems to be a gradual realization by the settlers that better results can be obtained by co-operation in building larger ditches following a higher level, from which laterals or subsidiary ditches can be run to the lands of each co-owner. By this means a much larger acreage can be irrigated than by the independent system and the proportionate cost of construction and maintenance should also be less if proper care is exercised in laying out the ditches. It naturally follows that still larger areas, and a larger proportion of the land, can be irrigated and the available water supply utilized to better advantage, by co-operation on a still larger scale. The main obstacle in the way of such development is the fact that the higher lands are as yet sparsely settled and the settlers are practically strangers to one another. Co-operation under existing conditions may scarcely be looked for at present, but may come later.

As co-operative ditch construction is not likely to be extensively practised in the near future, and as there are several large tracts of land unsuitable for settlement without irrigation, the policy has been adopted of disposing of large blocks of land to persons or companies, at a low price, subject to agreements to construct works for the irrigation of not less than twenty-five per cent of the area sold and to dispose of the land and water rights to actual settlers on terms satisfactory to the Minister of the

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Interior, or specified in the agreements. One such project, the canal system of the Alberta Railway and Irrigation Company, is in successful operation, and another, the Southern Alberta Land Company, has now been authorized and the contract has been let for the main diversion canal.

*The Southern Alberta Land Company.*

This company has been given permission to purchase some 380,000 acres between the Bow and Belly rivers and eastward from the junction of those streams towards Medicine Hat, and has been given the right to divert 2,000 cubic feet of water per second from the Bow river, during high water and flood stages of the stream only—the low water flow of the stream being already appropriated for other irrigation projects. As the diversion of water is limited to the high and flood stages of the stream it will be necessary, if the flow at low water is used by the first licensees, to divert a very large volume of water during the months of June and July of each year, and to store it for use during the later summer and autumn months and for use during the earlier part of the following spring. Fortunately the high-water flow of the Bow continues for a longer period than that of most of the rivers in the semi-arid tract, but notwithstanding this it will be necessary to construct a diversion canal of very large dimensions. This water is to be stored in a reservoir in Snake valley, to be known as Lake McGregor, so named in honour of the manager of the company. From this reservoir a canal will be built eastward to the tract to be irrigated and thence distributed by secondary canals and ditches to each farm. As a portion of the tract to be irrigated lies east of the Bow river it is the intention of the company to carry the water to the eastern tract by means of an inverted syphon.

Under the terms of the agreement the company is required to irrigate not less than twenty-five per cent of the lands purchased, or 95,000 acres. The quantity of water they are authorized to divert is sufficient, according to the present 'duty of water,' for the irrigation of 300,000 acres, if it could all be applied directly to the land. Allowance must, however, be made for seepage and evaporation and, as the water must be carried a long distance and stored in a reservoir for some time, these losses will be heavy. The loss by seepage will not be altogether wasted, as it will benefit the lands through which the canal passes, whether they are controlled by the company or not. It is the intention of the company to irrigate the largest possible percentage of the tract sold, as the larger the area irrigated the greater the profit to them from the sale of land. If the quantity of water reserved proves to be greater than the company can supply to beneficial use on the lands sold to them they will be required to dispose of the surplus to any whose lands can be served by their ditches.

*Alberta Railway and Irrigation Company's Irrigation Project.*

The Alberta Railway and Irrigation Company is the pioneer company in irrigation in Canada. Authorization was granted to the Alberta Irrigation Company in May, 1899, to divert water from the St. Mary river and other sources in southwestern Alberta and to construct a system of works for the irrigation of lands held by the Alberta Railway and Coal Company as part of their land grant. These lands lie between the line of the company's railway and the St. Mary river in the southern part of the province. The name of the company was subsequently changed to the Canadian Northwest Irrigation Company and, in 1904, by the amalgamation of this company with the Alberta Railway and Coal Company, the Alberta Railway and Irrigation Company was formed.

On October 22, 1902, authorization was granted to the last mentioned company to divert an additional quantity of water, and in December of the same year they

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were permitted to purchase a tract of 500,000 acres lying to the east of their land grant holdings. They were given a period of fifteen years from October 23, 1902, within which to complete their irrigation system. The following quantities of water have been granted to the company for irrigation purposes :—

Belly river, low water, 500 second feet.

St. Mary river, low water, total flow (about 600 second feet).

St. Mary river, high and flood, 2,000 second feet.

Milk river, low water, 500 second feet.

Milk river, high and flood, 1,500 second feet, and all the available water in certain minor streams in the vicinity of the lands to be irrigated.

The company at an early date took steps to colonize the lands tributary to their projected ditches and, as irrigation was then a new venture in Canada, they were instrumental in bringing in a number of Mormons and other settlers from the irrigation districts of the United States to settle upon and cultivate the lands. As a result of this policy several towns were established in the irrigated district and experience has proved the value of irrigation. Lands formerly used only for grazing now produce bountiful crops of many kinds and the culture of sugar beets has become a thriving industry. The towns of Raymond, Magrath and Stirling are the direct result of this irrigation enterprise and colonization scheme, and Cardston has also greatly benefited by the scheme.

Lands are sold by the company at \$5 per acre, without water rights, and from \$30 per acre with such rights. An annual charge of \$1 per acre is made for water, in addition to the price of the water right sold with the land. The water rights are appurtenant to the lands sold but are not perpetual and may be forfeited by non-use for two consecutive years.

There is a very large, but as yet undetermined, area of irrigable land in the district to which the works might profitably be extended, if the supply of water were sufficient, but the land available is greater than the water supply. A considerable portion of the tract irrigable from the constructed or projected canal system of this company was held by the company as a part of their railway land grant and it is upon these lands, now in private ownership, that the greatest development has so far taken place. It is proposed to extend the canal system eastward and to provide for the irrigation of as much land as the available water supply will permit.

Some 231 miles of canals have already been constructed, including 57 miles of natural channels used for the same purpose. The main canal has a capacity of 1,400 cubic feet of water per second. Distributing ditches are not included in the mileage mentioned as, under this company's system, such ditches are constructed by the water users, the company only building the canals and main laterals. The amount expended by the company on their canal system is about \$1,300,000.

A very profitable beet-sugar industry has been developed in the district tributary to this canal system; a factory costing in the neighbourhood of half a million dollars has been constructed and some 400,000 tons of beets are grown annually. Sugar-beets are also grown on the irrigated lands of the Canadian Pacific Railway Company, and a carload recently shipped from there to the factory at Raymond tested eighty-eight and one-tenth per cent for purity and nineteen and two-tenths of sugar in the beet. It is contended that the farther north the beet can successfully be grown the greater will be its purity and saccharine contents. The annual output of the Raymond factory is about five million pounds of sugar.

*Canadian Pacific Railway Company's Irrigation Project.*

The Canadian Pacific Railway Company have been given permission to consolidate a portion of their land grant and to acquire all the available lands (instead of alternate sections only) within a tract lying along the line of their railway eastward

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from Calgary, Alberta, and north of Bow river. This tract is approximately fifty miles wide by one hundred and fifteen miles long, and comprises some 3,000,000 acres. They have been given permission to divert water from Bow river, as follows :—

|                          | Second feet. |
|--------------------------|--------------|
| At low water.. . . . .   | 3,000        |
| At high water.. . . . .  | 13,000       |
| At flood water.. . . . . | 18,000       |

This quantity of water will be sufficient to irrigate, according to the present duty of water :

|                          | Acres.    |
|--------------------------|-----------|
| At low water.. . . . .   | 450,000   |
| At high water.. . . . .  | 1,950,000 |
| At flood water.. . . . . | 2,700,000 |

By means of storage reservoirs within the tract the company will probably be able to conserve and use sufficient water for the irrigation of some 2,000,000 acres, and surveys already made indicate that about this acreage is irrigable.

For convenience of operation this tract has been divided, by north and south lines, into three divisions of about equal area, but lands are at present sold in the western division only. This division lies immediately east of the city of Calgary and is being rapidly settled. The main and secondary canals have been constructed through most of this division, and work is being rapidly pushed on the laterals and distributing ditches, and no difficulty seems to be found in selling the lands when the ditches are constructed. One of the main ditches has been constructed for some distance across the second, or central, division of the tract and work is being pushed on this also.

The company have been given fifteen years from April 21, 1904, within which to complete their works and secure license for the water, but are permitted to use water during construction. Lands are sold at from \$15 per acre for non-irrigable to from \$25 to \$30 per acre for irrigable lands in most parts of the tract now for sale. The irrigable area on each parcel is determined by survey before sale is made. The purchaser agrees to pay to the company 50 cents per acre annually as water rates for the irrigable portion. This contract is perpetual and the water right is appurtenant to the land sold and to no other land and may not be sold, or transferred separately from the land.

The land comprised in this tract is high, rolling prairie and there are few perennial streams or other permanent bodies of water that might be of use for irrigation purposes. The Bow river flows along the entire southern boundary of the tract and the Red Deer and Rosebud rivers along its northern boundary. The Bow and Red Deer rivers flow in deep valleys and are therefore of little value for irrigation purposes without the construction of extensive works involving the expenditure of sums entirely beyond the means of settlers. The annual rainfall varies from eight to thirty-four inches, with a mean of seventeen inches for the past twenty years; the greater portion of this falls in the growing season from May to July. The soil is, on most of the tract, well suited to agriculture and the climate compares favourably with that of southern Manitoba and southeastern Saskatchewan where the country is well settled and crops are successfully grown without irrigation. Before this irrigation project was undertaken this land was used almost solely for grazing purposes and supported a very sparse population. With irrigation it is believed to be capable of supporting as large a population as any similar area of farming land elsewhere in Canada, and the crops already produced will compare favourably both in quantity and quality with those grown elsewhere.

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The estimated cost of these works is \$5,000,000, and the total length of the canal system, including distributing ditches will be in the neighbourhood of 2,900 miles.

*The Aylwin Scheme.*

Mr. F. P. Aylwin has been permitted to purchase a tract of some 69,000 acres in townships 14, 15 and 16, range 17, and township 14, range 16, west of the fourth meridian, subject to the construction by him of works for the irrigation of at least one-fourth of the area purchased. Authorization has not yet been granted for the construction of the works.

The agreement for the sale of the land is similar in most respects to other agreements that have been made for the same purpose. No restriction is placed upon the price at which the lands may be sold to settlers, but the annual rates to be charged for water are subject to the approval of the department. The important difference between this and other sales of land for irrigation purposes is that the land is to be sold at the rate of one dollar per acre, that no allowance on the purchase price is to be made for the cost of the works, and that for every dollar paid on account of the purchase price two dollars shall be deposited with the department as a guarantee for the proper fulfilment by the purchaser of his obligations to construct and maintain the necessary irrigation works, and to supply water for the irrigation of the required proportion of the lands sold to him, in accordance with agreements to be entered into by him for that purpose with persons to whom he may sell any of the lands.

It is further provided in this agreement that should the grantee fail to maintain and operate the works, or should he fail to supply water for irrigation purposes in accordance with agreements entered into by him for that purpose, the minister may take over and operate the works and the said works and the guarantee fund shall be forfeited to the Crown.

In addition to these large enterprises the development of irrigated farming by individuals is shown in the following schedule :—

| Smaller Irrigation Schemes.  | No. | Acres to be Irrigated. |
|------------------------------|-----|------------------------|
| Licensed.....                | 160 | 40,503                 |
| Construction authorized..... | 153 | 123,913                |
| Applications.....            | 21  | 12,480                 |
| Total.....                   | 334 | 176,896                |

While there is yet available on some of the smaller streams a portion of the ordinary low-water flow, most of the normal flow has been already appropriated and future diversions will, in most cases, be limited to high water and flood stages of the streams. This brings up an interesting question.

The unit of measurement of flowing water, as prescribed by the Irrigation Act, is the cubic foot per second, or second-foot, while the unit of quantity is the acre-foot, viz., 43,560 cubic feet, or sufficient to cover one acre to a depth of one foot. Licenses to divert water have heretofore authorized the diversion of a specified number of cubic feet per second flowing continuously throughout the irrigation season—from May 1, to September 30. This has been found satisfactory where the licenses have authorized the use of the low water, or normal, flow of the stream, which is continuous throughout the season, but where the right to divert is limited to the high water or flood period it is obvious that if sufficient water is to be obtained during such limited periods, for the irrigation of a given area, the rate of flow must be increased and a larger volume of water taken for a shorter time and stored for subsequent use.

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It seems therefore that a change might advantageously be made in the form of license and the quantity of water granted expressed in acre-feet.

As an illustration two cases may be cited: 'A' is given the right to water at all stages of the stream for the irrigation of 150 acres. According to the 'duty of water' this quantity is one second foot for 153 days, and his license is made to permit the continuous diversion of one second foot.

'B' is given the right to water from the same stream at 'high and flood stages' only, for the irrigation of the same acreage. The high water period on this stream may last for only two weeks, and it is obvious that if his license limits him to the diversion of one second foot of water during this period he will not get anything like the quantity necessary to irrigate 150 acres.

While licenses for the diversion of water for domestic, industrial and other purposes should be based upon the rate of flow (the second foot), it would be advantageous to adopt the acre-foot as the basis of all licenses for irrigation purposes. If this were done the licenses in the cases cited would permit of the diversion of 303 acre-feet during the irrigation season, or sufficient to cover each irrigable acre to a depth of two feet, and the commissioner of irrigation would be empowered to prescribe when and in what order each licensee might open his headgates and take water. In all high water and flood diversions storage reservoirs should be required and these should, wherever possible, be constructed elsewhere than in the bed of the stream, as experience has shown that reservoirs formed by damming torrential streams are usually quite expensive to maintain, owing to the necessity for constructing works of sufficient strength to withstand the annual floods.

#### *Watersheds.*

One great difficulty encountered in granting licenses to divert water from streams has been the exact determination of the relationship between a main stream and its tributaries. The volume of water in any stream is the sum of its tributaries and any diversion from a tributary will affect, to some extent, the volume available below the point of diversion on the same stream or in any into which its water flows. The practice, up to the present time, has been to treat each stream independently and to grant licenses up to the full flow of each stream, without regard to the effect of such diversions upon other streams of the same system, or watershed. This has been done in all cases, except where two or more branches of a stream bear the same name, as East, West and Middle Fork of, say, Fish creek; in such cases the several branches bearing the same name were treated as one stream and licenses were granted on any of the branches in order of priority. The system of treating the several branches as independent sources of supply has little to commend it, and the reason for the exception referred to is even more difficult to justify, as the name borne by a stream has obviously no bearing whatever upon the question.

The question is referred to by Inspecting Engineers R. J. Burley and P. M. Sauder in their reports for 1908, and is now receiving attention. The entire irrigation district has been divided into watersheds, or groups of streams, and careful measurements are being taken of the flow of each stream, with a view to determining the volume of water available for irrigation purposes in each and the effect of diversions from one upon the others of the same watershed. When fuller information has been obtained of the flow, and of the probable proportion of the diverted water that returns to the streams as seepage, it should be possible to devise some more satisfactory system of granting water licenses than that at present in force. The system of watersheds as defined on the map accompanying this report is doubtless imperfect in some respects; necessary corrections and changes can be made as soon as more accurate knowledge of stream flow becomes available.



*Reservoir Sites.*

The development of southwestern Saskatchewan and southern Alberta is dependent to a very large extent upon the quantity of water available for domestic, industrial and irrigation purposes, and the present rapid settlement of these districts, with its increased demands upon the streams, has emphasized the necessity for the construction of storage reservoirs in order to conserve and apply to beneficial use the vast quantities of water that annually run to waste during the spring freshets. Most of the principal streams of this district rise on the eastern slope of the Rocky mountains, or in the foot-hills, and are of the torrential class, carrying large volumes of water for short periods during early summer and dwindling to inconsiderable proportions during the later summer and fall months.

The losses which have been sustained during the past year in southern Alberta on account of floods in the rivers, and the annual loss by the lumbermen on the North Saskatchewan, the difficulties of navigation which result from uncontrolled floods and poorly sustained flow, the requirements of towns and villages for water supply, and of railways and other corporations for water for industrial purposes, in addition to the requirements of settlers for water for irrigation and domestic purposes, make this a question of such importance that the Dominion government, which is charged with the administration of the land and the water, may fairly be held responsible for obtaining the information necessary, to determine whether or not, or to what extent, the flow of these streams may be controlled. Whether the government should or should not construct the works that may be necessary need not at present be considered. What is necessary is that reliable data should be obtained and should be available when the necessity for undertaking the work arises. It will require careful and thorough examination for several years to secure the necessary data.

Realizing the importance of this question an effort is now being made to determine whether or not suitable sites can be found at the headwaters of the Bow and Waterton rivers, and on the southern slope of the Cypress hills for the construction of reservoirs for the storage of the water that has heretofore run to waste. It is the intention to make reconnaissance surveys during the present season with a view to the location of suitable reservoir sites, to determine the catchment area tributary to each site and the probable annual run-off. The work this season will be merely of a preliminary nature, but should give results from which to determine more accurately the possibilities of controlling the streams and the nature and approximate location of the necessary reservoirs.

*Drainage.*

It is provided by the Irrigation Act that the property in and the right to the use of all water in any stream, &c., within the district to which the Act applies, shall be deemed to be vested in the Crown, and that no person shall divert or use water otherwise than in accordance with the provisions of the Act.

Irrigation is not required in the northern portions of the provinces of Alberta and Saskatchewan, and in some portions of both provinces drainage is required, rather than irrigation. All drainage works are under the direct control of the provincial governments, but as the water in the lakes, sloughs, marshes, &c., is the property of the Dominion government, the resultant situation has been somewhat unsatisfactory, as no provision had been made for the acquirement of a right to drain away water from any source without complying with all the provisions of the Irrigation Act and securing a license to do so.

Realizing the importance of drainage and the desirability of simplifying the procedure for permission to drain swamps and sloughs, the Irrigation Act was amended at the session of parliament for 1903 so as to provide that the Minister of the Interior may, upon the application of the proper officer of the province, approve

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of the construction of any ditch or drain authorized by the provincial authorities, upon the filing with the Commissioner of Irrigation of plans of the proposed works, and upon a report by the commissioner that the said works will not injuriously affect any existing irrigation project or the future development of irrigation. Upon receipt of such a favourable report the minister may authorize the necessary diversion of water, and no further or other license shall be necessary. The present procedure is very simple and has so far worked admirably.

#### *Accounts.*

When the Irrigation Act was first passed, in 1894, surveys were undertaken, under the direction of the Surveyor General, for the purpose of determining the extent of territory that could be irrigated from the available water supply, and efforts were at the same time made to ascertain the quantity of water available for the purpose. Contour surveys were carried on for several years and bench marks were established at convenient points as bases for future operations. Owing to a variety of causes these surveys were not continued, and for several years little or no actual survey work has been done, operations being confined almost entirely to the necessary inspections of irrigation projects either under construction or proposed.

As these earlier operations were carried on under the direction of the Surveyor General, the control of the expenditure was also left in his hands. Recently, however, all matters in connection with irrigation administration have been placed under my charge and, as I am to be held responsible for the proper carrying on of the work, the control of the expenditure has also been entrusted to me.

Some changes have been made in connection with the rendering of accounts of expenditure. Accounts are in future to be rendered monthly instead of annually and advances are not to be made, as a general rule, until the previous month's accounts have been received. Estimates are to be submitted monthly for the amount required for the succeeding month's expenditure and must be approved before the proposed expenditure can be made. The permanent officers of the commissioner's staff are to be paid monthly from Ottawa instead of directly by the commissioner as formerly. In short, the office of the Commissioner of Irrigation is to be dealt with, as far as is possible, in the same manner as are the Dominion Lands and Crown Timber agencies. These changes imply no criticism of the methods followed by the commissioner in past years, but are merely part of the policy of more effectively controlling all branches of the department which are charged with the expenditure of public funds. The same rule is to be followed in dealing with expenditure for hydrographic surveys.

#### *Hydrographic Survey.*

From the date of the enactment of the 'Northwest Irrigation Act' in 1894, up to the present time, some attention has been paid to gauging streams in the semi-arid districts, but these measurements have not been made in a systematic manner nor with sufficient frequency. The result is that we have a number of measurements of the volume of water in certain streams on certain dates, from which it is possible to estimate with an approach to accuracy the volume carried by those streams at 'low,' 'high' and 'flood' stages; but we have no accurate record of the duration of the high and flood stages and consequently little real knowledge of the total flow of the streams throughout the season or of the quantity of water that may be relied upon at any season. As requests for water for irrigation and other purposes became more frequent, this lack of knowledge of stream flow seriously interfered with irrigation administration, and it became apparent that a more accurate knowledge was absolutely essential to the proper development of the country and the supply of water for its varied necessities.

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In the latter part of 1907, Mr. P. M. Sauder, an inspecting engineer on the staff of the Commissioner of Irrigation, secured permission to visit the United States to look into the question of stream measurement as carried on there by the Geological Survey, with a view to the organization of a somewhat similar service in Canada. Mr. Sauder had had some experience in stream measurement during his service as an inspecting engineer and was convinced of the necessity for reorganizing the system upon which such work has previously been done in Canada in order to obtain satisfactory results. He visited the State of Montana, which was most convenient to the district in which he was then employed, and, through the courtesy of Mr. Follansbee and other officers of the United States Geological Survey, was furnished with much valuable information as to the manner in which the work was carried on there and was permitted to visit gauging stations and see the actual work performed in connection with stream measurements. Much of his report deals with technical matters, but some extracts which may be of general interest are submitted as an appendix to this report; they show the gradual growth of the service in the United States, the general methods used and the manner in which a similar service could be organized and maintained in Canada.

An appropriation of \$10,000 was made by parliament during the session of 1908 for the establishment of systematic stream measurements, but it was found impossible to organize such a service in time to be of much use during that year. Equipment was, however, purchased and steps taken for organizing the service during the present year. Only a portion of the vote for 1908 was used and a similar vote was taken for the current year.

The organization follows very closely the plan outlined by Mr. Sauder. The irrigation tract has been divided, for administration purposes, into three districts, viz., Calgary, Lethbridge and Maple Creek, and in each district there is one hydrographer and one assistant. Each party is equipped with a team and light wagon and the necessary gauging and surveying instruments, and is expected to establish gauging stations on all of the more important streams in the district and to arrange with residents to take daily readings of the height of water as shown on the gauge rods, and to forward weekly reports to the chief hydrographer at Calgary. Mr. P. M. Sauder has been placed in charge of the service and, in addition to organizing and supervising the work elsewhere, has personal charge of the Calgary district. Mr. H. C. Ritchie has charge of the Lethbridge district and Mr. H. R. Carseallen of the Maple Creek district. The last mentioned district is too large to be covered by one field party and, if funds permitted, it would be advisable to place an additional party, consisting of one hydrographer and one helper, in the southern part of the district. The amount voted for this work is very small when the extent of territory to be covered is taken into consideration. As the service is, as yet, organized on experimental lines, it was impossible to estimate accurately the cost of equipping and maintaining field parties, and already there is evidence that the most rigid economy must be practised in order to keep the expenditure within the limits of the appropriation.

*Irrigation Map.*

The Irrigation Act requires each applicant for water rights to file with the Commissioner of Irrigation, and in the Department of Interior, a plan showing the source of supply, the point at which water is to be diverted, the canals or ditches and the lands to be irrigated. These plans, while showing clearly enough the projects in connection with which they were filed, failed to show the connection between such projects and others in the same neighbourhood. As irrigation projects multiplied on some of the streams it became desirable to have a map at headquarters upon which each project could be plotted as soon as it became authorized so that the relationship between the various projects and the development in different portions of the country could readily be seen.

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Such a map was prepared and kept constantly on the draughting table for reference purposes and it has been found so useful that other features have been added during the year, such as diversions of water for domestic and industrial purposes, the more important irrigation bench marks and the watershed divisions. Topographical features have been purposely omitted, in order that the irrigation projects might be more clearly shown. A limited edition of the map has been published in the hope that it may be of use to intending irrigators. Other useful information may be added as irrigation develops. Separate watershed maps and others showing lands sold in connection with irrigation projects are kept in the office at Ottawa for reference purposes and all these are kept constantly up to date.

Respectfully submitted,

R. H. CAMPBELL,  
*Superintendent of Forestry and Irrigation.*

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*(Translation.)*

PRAIRIE AND FOREST FIRE LAWS FOR THIS COUNTRY.

TAKE NOTICE.

Any one who purposely or not purposely or his servant or his companion :

- (1) Makes a fire and allows it to run on anybody else's land not his own, or,
- (2) Allows a fire to run from his own land, or,
- (3) By his doing or by his servant's doing, allows any fire to run, will have to pay \$200.

*About Camping.*

Any one, or any one that is with him, who lights a fire in the open for camping, and leaves it without putting it out, will have to pay \$100.

*Those who must go and help put out a fire.*

Those who are grown up and have not reached 60 years of age, being within 10 miles of a prairie fire or 15 miles of a bush fire, and being called upon to help put it out, refuse to help, will have to pay \$5.

(Sgd.) R. H. CAMPBELL,

*The one who is the head of this work.*

Department of the Interior,  
Ottawa, 1908.

Any one who tears down or destroys this notice will be put in prison.

## REGULATIONS FOR CAMPING SITES IN THE FOREST RESERVES.

(1) At all places suitable for public camping sites, such as lake fronts, medicinal springs, fishing grounds, or other similar locations, such area in each case as may be considered sufficient by the officer in charge of the reserve shall be reserved and set apart for the use of the general public before any individual rights are granted.

(b) The use of the public area for camping or picnicking will be allowed without special permit.

(c) Persons making use of the public area will be subject to the regulations governing the reserve, particularly those relating to the cutting of timber, the use of fire and the protection of fish and game.

(2) Leases of lots for camping sites not exceeding one acre in area and not covering more than one hundred feet of water frontage may be granted, but no lease shall be granted which will obstruct any established trails or prevent the general public from reaching springs, lake shores, fishing grounds or points of interest.

(b) The location, size and shape of such lots shall be subject to the approval of the officer in charge of the reserve.

(3) All lots shall be surveyed before occupation and the boundaries shall follow the cardinal directions wherever the topography permits. The boundaries shall be marked by blazed lines and stakes, mounds or monuments shall be erected at the angles.

(4) The annual rental for a lot shall be five dollars, payable each year on or before the first day of May, and if rental is not paid within thirty days of the date when it becomes due the lease may be cancelled.

(5) Leases shall be renewable yearly for a term of ten years but may be terminated by the Minister of the Interior at any time when it is found necessary in the interests of the forest reserve.

(b) No transfer or sub-lease shall be made without the consent of the Minister of the Interior.

(6) Leases upon a water front shall be subject to a reservation of a public shore allowance of fifty feet in width measured from high water mark. The lessee may, subject to the approval of the officer in charge of the reserve, clear and improve such public shore allowance but no buildings, fences or other structures, which will interfere with or obstruct public passage along the shore, shall be erected.

(7) Lessees will be permitted to erect buildings upon the lands leased, but no unsightly structures will be allowed, and the premises must be kept in a sanitary condition.

(8) A lease shall not convey the right to cut or remove any trees or timber without the consent of the officer in charge of the reserve.

(9) Lessees and occupants of leaseholds shall be subject to all the regulations in force in the reserve, particularly those relating to the cutting of timber, the use of fire and the protection of fish and game, and shall be required to render assistance free of charge in fighting fires.

(10) Any lessee in occupation of a leasehold shall be allowed the privilege of grazing free, on the reserve, the stock actually used by him, not to exceed five head.

(11) No application for a lease for commercial purposes or for a larger area than one acre shall be granted.

## APPENDIX No. 1.

## REPORT OF THE INSPECTOR OF FOREST RESERVES.

March 3, 1909.

R. H. CAMPBELL, Esq.,  
 Superintendent of Forestry and Irrigation,  
 Ottawa.

SIR.—I have the honour to submit my first report upon the Dominion Forest Reserves, having been appointed to the office of Inspector of Forest Reserves, January 1, 1908.

It seems to me appropriate that the report should begin with the list of the reserves, showing their location and area and dates of formation, as no complete list has heretofore been published. The work on the forest reserves for the past year has included the operations incidental to grazing, protection against fire, reforestation, removal of squatters, marking reserve boundaries, forest surveys, map-making, examination of lands with view to the creation and extension of forest reserves, examinations of the shores of lakes to ascertain their suitability for pleasure resorts, granting of permits for the removal of timber, suppression of timber stealing, collection of statistics showing the timber on the reserves and the quantity removed therefrom, and various other duties connected with the care and management of the forest reserves.

## LOCATION AND AREA.

The Dominion Forest Reserves all lie in the northwestern provinces. They are twenty-six in number, including the parks whose timber is managed in precisely the same way as that of the timber reserves proper. The number twenty-six does not include the eastern slope of the Rockies, however, although it also is under management similar to that of the forest reserves. Manitoba has six reserves, namely:—

|   | Square miles. |
|---|---------------|
| Riding Mountain reserve, containing. . . . .    | 1,535         |
| Duck Mountain reserve, containing. . . . .      | 1,251         |
| Poreupine No. 1 reserve, containing. . . . .    | 322           |
| Lake Manitoba West reserve, containing. . . . . | 248           |
| Spruce Woods reserve, containing. . . . .       | 110           |
| Turtle Mountain reserve, containing. . . . .    | 109½          |
| Total. . . . .                                  | 3,575½        |

Saskatchewan has four, namely:—

|  | * Square miles. |
|--|-----------------|
| Poreupine No. 2 reserve, containing. . . . . | 360             |
| Moose Mountain reserve, containing. . . . .  | 163             |
| The Pines reserve, containing. . . . .       | 145             |
| Beaver Hills reserve, containing. . . . .    | 72              |
| Total. . . . .                               | 740             |



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Alberta has six, namely:—

|   | Square miles. |
|---|---------------|
| Jasper Park reserve, containing. . . . .          | 5,000         |
| Rocky Mountains Park reserve, containing. . . . . | 4,500         |
| Cooking Lake reserve, containing. . . . .         | 114           |
| Kootenay Lakes, containing. . . . .               | 54            |
| Cypress Hills, containing. . . . .                | 18            |
| Elk Island, containing. . . . .                   | 16            |
| Total. . . . .                                    | 9,702         |

British Columbia has ten, namely:—

|  | Square miles. |
|--|---------------|
| Yoho Park reserve, containing. . . . .       | 828½          |
| Glacier Park reserve, containing. . . . .    | 576           |
| Hat Creek reserve, containing. . . . .       | 208           |
| Long Lake reserve, containing. . . . .       | 190           |
| Tranquille reserve, containing. . . . .      | 149           |
| Niskonlith reserve, containing. . . . .      | 124½          |
| Monte Hills reserve, containing. . . . .     | 106           |
| Donald reserve, containing. . . . .          | 72            |
| Larch Hills reserve, containing. . . . .     | 25            |
| Martin Mountain reserve, containing. . . . . | 18            |
| Total. . . . .                               | 2,297         |

Summarizing:—

|                           | Sq. miles. | Acres.     |
|---------------------------|------------|------------|
| Manitoba has. . . . .     | 3,575¼     | 2,288,160  |
| Saskatchewan. . . . .     | 740        | 473,600    |
| Alberta. . . . .          | 9,707      | 6,209,280  |
| British Columbia. . . . . | 2,297      | 1,470,080  |
| Grand Total. . . . .      | 16,314¼    | 10,441,120 |

## DATES OF FORMATION.

The Dominion government awoke to the necessity of forming forest reserves in 1887, and has been constantly moving forward in that direction, thus conserving the timber, ever since that date, as appears from the following table which gives the dates when the reserves were set aside.

- 1887, June 23.—Rocky Mountains Park reserve, by Act of parliament.
- 1888, October 11.—Glacier Park reserve, by Order in Council.
- 1894, December 29.—Moose Mountain reserve, by departmental order.
- 1895, May 30.—The Kootenay Lakes reserve, by Order in Council.
- 1895, July 13.—Riding Mountain reserve, by departmental order.
- 1895, July 13.—Lake Manitoba West reserve, by departmental order.
- 1895, July 13.—Spruce Woods reserve, by departmental order.
- 1895, July 13.—Turtle Mountain reserve, by departmental order.
- 1899, June 5.—Cooking Lake reserve, by departmental order.
- 1901, December 14.—Yoho Park reserve, by Order in Council.
- 1901, August 29.—Beaver Hills reserve, by departmental order.
- 1902, November 3.—Long Lake reserve, by departmental order.
- 1902, November 3.—Rocky Mountain reserve, extended 152 townships by Act of parliament.

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1903, November 26—Glacier Park reserve, extended 16 townships by Order in Council.

1905, November 14.—The Pines reserve, by departmental order.

1906, July 13.—Duck Mt. reserve, by Act of parliament.

1906, July 13.—Duck Mountain reserve, by Act of parliament.

1906, July 13.—Porcupine No. 2 reserve, by Act of parliament.

1906, July 13.—Cypress Hills reserve, by Act of parliament.

1906, July 13.—Monte Hills reserve, by Act of parliament.

1906, July 13.—Martin Mountain reserve, by Act of parliament.

1906, July 13.—Niskonlith reserve, by Act of parliament.

1906, July 13.—Tranquille reserve, by Act of parliament.

1906, July 13.—Hat Creek reserve, by Act of parliament.

1906, July 13.—Donald reserve, by Act of parliament.

1906, July 13.—Larch Hills reserve, by Act of parliament.

1906, July 13.—Elk Island reserve, by Order in Council.

1907, September 14.—Jasper Park reserve, by Order in Council.

1907, September 17.—Yoko Park, reduced 105 square miles, by Order in Council.

The work of making forest reserves is still progressing, and will need to progress in Canada for many years. This year the region around the Waterton lakes in south-western Alberta was examined for this purpose. The forester who examined it recommended that 195 square miles be set aside. Also, territories adjacent to certain reserves have been examined with a view to ascertaining their suitability to be added. Recommendations have been made that 130 square miles be added to the Spruce Woods reserve in Manitoba, 238½ square miles to the Pines reserve in Saskatchewan, 45 square miles to the Beaver Hills reserve in Saskatchewan and 192 square miles to the Cypress Hills reserve in Alberta. Chiefly land unsuitable for agriculture or grazing has been recommended to be put into forest reserves.

#### GRAZING ON FOREST RESERVES.

It does not seem to me that the department, however, should exclude from the reserves all land suitable for grazing. In fact, they already include large grazing areas, and, if the recommendations made this year be sustained, such areas will be added to the Cypress Hills and Beaver Hills. These areas are among timber, and so we include them, rather than to exclude the timber. Nor should the department prevent grazing on these areas. For several reasons it is desirable that they should be grazed. The forest reserves are for the use of the people; then why should good grass be allowed to go to waste if it can be utilized? The grazing may be desirable also as a protection to the woods. In some places the ground is covered with a dense growth of long grass and peavine. This, when dry, offers much fuel for fire; and when the fire once gets into it, it is almost impossible to check the flames. Cattle on the prairie have much the same habit as the buffalo. In going to water they follow one another and make paths which they follow day after day. These paths are fire lines where the fire may be checked, small to be sure, but there are many of them, and they give lines from which to back-fire.

Perhaps it will be objected that grazing prohibits the reproduction of timber. It seems to me, however, that the interference with reproduction from this cause is much overestimated. I know in the west many fields grazed constantly that have come into timber. There is danger from overgrazing, but from judicious grazing there is much less danger than from long grass and peavine.

#### PROTECTION AGAINST FIRE.

The problem of protecting the forest reserves against fire is the most difficult one we have. The fire problem is difficult even in the eastern provinces; but the

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conditions for fighting fire here are very favourable as compared with those prevailing in Manitoba, Saskatchewan, Alberta and eastern British Columbia. Compare, for instance, the number of rainy days for the summer months at Calgary, Alberta; Qu'Appelle, Saskatchewan; Winnipeg, Manitoba; and Toronto, Ontario. In our comparison, however, we must not only consider the number of rainy days but also the quantity of rain falling on those days; because, although a day may be considered rainy, there may not be precipitation enough to count much towards putting out a forest fire. The following table is a comparison for the four places mentioned, showing the average number of rainy days in each of the summer months and the average quantity of rain falling in those months. It is compiled from statistics furnished by the Meteorological Service published in a volume entitled 'Rain and Snowfall of Canada.'

TABLE OF RAINY DAYS.

(Average 1883 to 1902—20 Years.)

| —                 | Jan. | Feb. | Mar. | April. | May.  | June. | July. | Aug.  | Sept. | Oct.  | Nov.  | Dec. | Totals |
|-------------------|------|------|------|--------|-------|-------|-------|-------|-------|-------|-------|------|--------|
| Calgary, Alta..   | 0·20 | 0·06 | 0·33 | 2·93   | 9·40  | 12·93 | 12·00 | 8·66  | 6·93  | 2·79  | 2·66  | 0·26 | 59·15  |
| Qu'Appelle, Sas.  | 0·25 | 0·30 | 0·40 | 4·00   | 8·80  | 12·65 | 11·90 | 8·35  | 8·15  | 4·70  | 0·90  | 0·30 | 60·70  |
| Winnipeg, Man.    | 0·45 | 0·25 | 1·20 | 6·80   | 9·15  | 13·40 | 12·25 | 12·25 | 11·05 | 8·45  | 1·60  | 0·07 | 76·92  |
| Toronto, Ont. . . | 5·30 | 5·75 | 6·70 | 9·30   | 13·30 | 11·35 | 11·95 | 10·35 | 11·05 | 13·20 | 11·15 | 7·45 | 116·85 |

TABLE OF RAINFALL IN INCHES.

(Average 1883 to 1907—25 Years.)

| —                  | Jan.  | Feb.  | Mar.  | April. | May.  | June. | July. | Aug.  | Sept. | Oct.  | Nov.  | Dec.  | Totals |
|--------------------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Calgary, Alta. . . | 0·013 | 0·016 | 0·024 | 0·262  | 2·010 | 3·060 | 2·630 | 2·490 | 0·991 | 0·191 | 0·004 | 0·005 | 11·696 |
| Qu'Appelle, Sas.   | 0·002 | 0·085 | 0·036 | 0·356  | 1·785 | 3·580 | 2·594 | 1·750 | 1·446 | 0·463 | 0·400 | 0·072 | 13·336 |
| Winnipeg, Man.     | 0·005 | 0·003 | 0·160 | 1·142  | 1·858 | 3·319 | 3·003 | 2·209 | 1·253 | 1·290 | 0·728 | 0·013 | 14·983 |
| Toronto, Ont. . .  | 1·128 | 0·954 | 1·360 | 1·467  | 2·754 | 2·844 | 2·856 | 2·624 | 2·855 | 2·532 | 2·104 | 1·563 | 25·041 |

It would appear from these tables that Toronto is at a slight disadvantage in the month of June. But of all the summer months, June, July and August offer the least danger to the forest. In these months the grass is green, the leaves are out on the shrubs and trees, the sap is in the bark, and the ground is moist from the shade of the trees. The chief danger periods are in the spring before June, and in the fall after September, when the woods are dry.

The eastern provinces have a great advantage also in regard to the wind. The average hourly velocity of the wind at Winnipeg for the eight summer months of 1905, as stated by the Meteorological Service, was 14.87 miles per hour, while at Toronto it was only 7.36 miles per hour; just twice as great at Winnipeg as at Toronto. The people of the east were fortunate in that respect last summer. Had the wind here been as high as in the west, quite likely there would have been twice the quantity of timber destroyed. Then, in the east the winds are moist; there is no dry chinook.

Again, in respect to population the east has the advantage. When a forest fire starts in Ontario or Quebec, you can just go out to the 100-acre farms, and to the numerous small villages and soon have a force of men to put it under control. But

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in the Northwest the population is scarce, railroads are not so numerous, and telephonic communication is not so good. In that country we cannot count much on putting out forest fires and so we have to be all the more diligent to see that fires do not get started.

The reserves are under constant patrol, summer and winter. During the danger periods the rangers lay aside all other duties and guard the forest against fire. In 1908, we had only two fires of any consequence, one in the Pines reserves which burned over 22 square miles, destroyed no merchantable timber, and one in the Turtle mountains, extending over 28 square miles, mostly covered with grass. In each of these fires, however, large areas of young reproduction growth were destroyed.

Last year we began a practice which we know saved the reserves several fires. It is a well known fact that, in the early spring, the fields become bare and the grass dry before the snow is all gone from the woods. While such conditions existed the forest rangers burned the meadows along the reserve boundaries. Fires, coming in from the prairie, met this wide fire line and died out for want of fuel. Around the Riding mountains the meadows were burned for ninety miles, around the Duck mountains for forty-two miles, and around the Porcupine mountains for thirty miles; all these in the most dangerous places. It is advisable to extend this practice to all the reserves wherever it is practicable, and to carry it out upon an extensive scale.

Ploughed fire guards also should be made around and across some of the reserves. The forest ranger on the Cypress Hills has instructions to plough a guard of four furrows entirely around the reserve, and outside of this four rods distant from it a second guard. Then, on calm days, with the help of two or three men he is to burn the grass between the two guards. On the Spruce Woods reserve several guards should be ploughed, one of which should run along each side of the Canadian Northern Railway which crosses the reserves.

Roads along the boundaries and through the reserves are being constructed to aid in fighting fire. One hundred and fifty miles was made this year. In certain places these roads are very much needed. For instance, I noticed in my inspection of the Turtle Mountain reserve that the roads all run north and south. There is no way of going promptly and conveniently east and west. The fires mostly come in from Dakota which lies to the south. Therefore, to facilitate the fighting of fire the forest ranger was instructed to make a road following the southern boundary. This will not only make it easier to move about on the reserve but it will serve as a fire line from which back-firing may be done.

#### REFORESTING.

The department is making an attempt to reforest some of the areas denuded by fire. From some experiments made last spring, it would appear that this might be accomplished by putting down a few seeds with a handful of sand over them at each place where we wish to have a forest tree. This was tried on the Turtle mountains and on the Spruce Woods reserve. In the former it was successful, in the latter unsuccessful. On the Turtle mountains the seed was thus placed under poplars and among long grass. The following species were planted: White Pine, Norway Pine, Jackpine, Bull Pine, White Spruce, Red Spruce, Colorado Blue Spruce, Engelmann Spruce and Balsam. Among the poplars the seed was evidently taken by birds, rodents or insects; but in the long grass every species germinated, and just before snow-fall the trees were alive and looking well.

It is advisable to carry on a variety of such experiments next summer. For this purpose the forest ranger on the Spruce Woods reserve collected last fall 40 bushels of Spruce cones, the ranger on the Cypress Hills 40 bushels of Lodgepole Pine, and a party of foresters working on the Pines reserve 50 bushels of Jackpine. These are the species with which we hope to achieve success as they are the ones likely to prove hardy.

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We shall do our best to win along this line, because the method of raising trees in nurseries until they are three or four years old and then setting them out into the field is far too slow and too expensive a method to count much towards meeting the demand for wood that will develop on this continent during the next hundred years. The nursery method is simply gardening. It is a good method for the farmer's woodlot. Foresters should, however, seek for a method commensurate with the needs of the government lands. In the meantime, however, we are not despising the gardening method even on the reserves. We may be forced to use it, and next spring we shall start some seed beds. In fact 35,000 trees have already been planted on the Spruce Woods reserve, from stock raised at the forestry farm at Indian Head.

## REMOVAL OF SQUATTERS.

A large number of people, mostly foreigners, had located and started farming operations upon the reserves, expecting some time in some way, political or otherwise, they would be permitted to make entry for the places they occupied. The department determined upon their removal. They numbered one hundred and twenty-six on the Riding mountain, and twenty-five on the Turtle Mountain reserve. The task of removing these people was a delicate one and required great judgment and courage on the part of the forest rangers. The chief ranger of the Riding mountains, W. A. Davis, devoted the entire summer to the work. All the squatters have been removed except three on the Riding mountains and two on the Turtle mountains. These remaining ones will move early next spring.

In this work the department followed a lenient policy. The squatters were taken to look over lands in wagons furnished to them free of charge. They got free entry for the lands they selected, and they received compensation for improvements they had on the forest reserves. The total cost of removing all these people was only \$6,000. They have all made affidavits stating that they have been well treated and are pleased with the change.

## MARKING RESERVE BOUNDARIES.

In order that the public may not unintentionally trespass upon the forest reserves thinking themselves on private property, or on other Dominion lands, the department began last year to mark the boundaries with iron posts. These are three-cornered and hence differ in shape from the regular Dominion survey posts. They are marked with the letters 'D. F. R.' (Dominion Forest Reserve), and the part that projects out of the ground is painted red so that it will be readily observable, summer and winter.

Considerable work was done in this direction last year. Mr. David Beatty, a Dominion land surveyor, was at work with a party of men on the unsurveyed portion of the boundary of the Porcupine reserve and ran fifty-one miles of the line. The forest rangers are working on the boundaries that have been surveyed and have located 140 miles.

This work was in many places difficult of accomplishment. It was about thirty years since the lines had been surveyed and some of them having been burned over, the wooden posts had been destroyed and the mounds almost obliterated. People familiar with the west know, also, that mosquitoes and flies are numerous and troublesome in the summer months. As it is the intention to have the boundary line a road from which fire can be fought it was cut out from six to eight feet wide.

Much more of this work would have been done if the rangers could have begun early in the spring, but during the early part of the summer they were all busy with the removal of squatters.

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## FOREST SURVEY.

In order that the department may have a thorough knowledge of the reserves and be able to form a judgment as to how the tree growth thereon should be managed, a timber and topographic survey is being conducted. Last summer Assistant Inspector MacMillan with a party of five forestry students conducted such survey of the Pines reserve. Assistant Inspector Dickson did similar work with a party of thirteen in the Riding mountains. This survey serves a double good purpose. It gives the department the knowledge it desires and gives the students the practical side of their forestry course.

The timber survey makes a thorough study of the tree growth. It gives the areas covered with mature timber and with younger timber and states the quantity of each. It considers the accretion and reproduction of timber in the forest and discovers means for their encouragement in quantity and quality. It examines areas having no tree growth, and recommends methods by which they may be afforested. It studies the effect of past management upon the forest, and advises improvements for the future. It suggests means by which dangers to the forest from fire, storms, fungi and insects may be reduced. It investigates the utilization of the forest, and seeks new uses for forest products.

The topographic survey describes the hills and valleys, the lakes, streams and trails. It studies the best routes for the removal of the mature timber and locates trails for protecting the forest against fire.

## KINDS OF TIMBER.

The following species of trees exist in commercial quantity on the forest reserves:

Poplar (*Populus tremuloides* Michx.) and Balm of Gilead (*Populus balsamifera* Linn.) exist on all reserves east of the Rockies. Poplar reaches a maximum size of 32 inches at breast height. Fifteen inches, however, is the largest common size for sound trees. Balm of Gilead reaches a maximum of 34 inches, with a common large size, sound, of 18 inches.

White spruce (*Picea canadensis* [Mill.] B.S.P.) and black spruce (*Picea mariana* [Mill.] B.S.P.) exist on all reserves east of the Rockies, except Turtle mountain, Moose mountain, Beaver hills, Cooking lake, Elk island and Buffalo Park reserves. Maximum 48 inches; common large, sound, 18 inches.

Engelmann spruce (*Picea engelmanni* Engelm.) exists on the Kootenay lakes, Jasper Park, Rocky Mountains Park and all British Columbia reserves. Maximum, 30 inches; common large, sound, 16 inches.

Jackpine (*Pinus banksiana* Lamb.) exists on all Manitoba reserves, except the Spruce Woods and Turtle mountain. In Saskatchewan it appears in the Porcupine and the Pines reserves. Maximum, 20 inches; common large, sound, 12 inches.

Lodgepole pine (*Pinus contorta*, var. *Murrayana* [Engelm.] B. and W.) exists on the Cypress hills, Kootenay lakes, Jasper Park, Rocky Mountains Park and all British Columbia reserves. Maximum, 20 inches; common large, sound, 14 inches.

Bull pine (*Pinus ponderosa* Laws.) exists on all British Columbia reserves. Maximum, 36 inches; common large, sound, 26 inches.

Western White pine (*Pinus monticola* Dougl.) exists on all British Columbia reserves. Maximum, 32 inches; common large, sound, 24 inches.

Tamarack (*Larix americana* Michx.) exists on all the Manitoba reserves, except Turtle mountain. It occurs on the Pines and Porcupine reserves in Saskatchewan, and on the Jasper Park in Alberta. Maximum, 24 inches; common large, sound, 14 inches.

Western larch (*Larix occidentalis* Nutt.) exists on all the British Columbia reserves. Maximum, 30 inches; common large, sound, 24 inches.

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Douglas fir (*Pseudotsuga mucronata* Sudw.) exists on the Kootenay lakes, Jasper Park, Rocky Mountains Park and all British Columbia reserves. Maximum, 36 inches; common large, sound, 24 inches.

Balsam (*Abies balsamea* [Linn.] Mill.) exists on Riding mountain, Duck mountain, Porcupine and Lake Manitoba West reserves. Maximum, 17 inches; common large, sound, 10 inches.

Western cedar (*Thuja plicata* Don.) exists on all British Columbia reserves. Maximum, 84 inches; common large, sound, 40 inches.

Western hemlock (*Tsuga mertensiana*, authors) exists on the British Columbia reserves. Maximum, 35 inches; common large, sound, 10 inches.

White birch (*Betula papyrifera* Marsh.) exists on the Manitoba reserves. Maximum, 26 inches; common large, sound, 14 inches.

There are also on the Manitoba reserves small quantities of merchantable green ash (*Fraxinus lanceolata* Borkh.). Maximum, 12 inches; common large, sound, 8 inches. Bur oak (*Quercus macrocarpa* Michx.) Maximum, 27 inches; common large, sound, 10 inches. Manitoba maple (*Acer negundo* Linn.). Maximum, 11 inches; common large, sound, 7 inches.

## TIMBER ESTIMATES.

As has been previously stated, the department is making a forest survey of the reserves which should give a close estimate of the timber thereon. Such estimate has been made for the Riding mountain, Turtle mountain, Moose mountain and the Pines reserves, and the following figures are probably close to the actual quantities on these reserves. For all other reserves the estimates are only tentative:—

*Manitoba Reserves.*

|                             | Saw Timber.<br>Bd. ft. | Fuel Wood.<br>Cords. |
|-----------------------------|------------------------|----------------------|
| Duck Mountain. . . . .      | 300,000,000            | 3,000,000            |
| Riding Mountain. . . . .    | 250,000,000            | 2,500,000            |
| Porcupine No. 1. . . . .    | 50,000,000             | 750,000              |
| Turtle Mountain. . . . .    | 1,333,000              | 135,000              |
| Spruce Woods. . . . .       | 1,000,000              | 30,000               |
| Lake Manitoba West. . . . . | 600,000                | 40,000               |
| Total. . . . .              | 602,933,000            | 6,250,000            |

*Saskatchewan Reserves.*

|                          | Saw Timber.<br>Bd. ft. | Fuel Wood.<br>Cords. |
|--------------------------|------------------------|----------------------|
| Porcupine No. 2. . . . . | 50,000,000             | 500,000              |
| Moose Mountain. . . . .  | 5,000,000              | 130,000              |
| The Pines. . . . .       |                        | 50,000               |
| Beaver Hills. . . . .    |                        | 10,000               |
| Total. . . . .           | 55,000,000             | 690,000              |

*Alberta Reserves.*

|                               | Saw Timber<br>Bd. ft. | Fuel Wood.<br>Cords. |
|-------------------------------|-----------------------|----------------------|
| Eastern Slope. . . . .        | 3,000,000,000         | 50,000,000           |
| Rocky Mountains Park. . . . . | 300,000,000           | 3,000,000            |
| Jasper Park. . . . .          | 100,000,000           | 1,000,000            |
| Cypress Hills. . . . .        | 2,000,000             | 100,000              |
| Cooking Lake. . . . .         |                       | 10,000               |
| Elk Island Park. . . . .      |                       | 10,000               |
| Total. . . . .                | 3,402,000,000         | 54,220,000           |

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*British Columbia Reserves.*

|                                     |                        |                      |
|-------------------------------------|------------------------|----------------------|
|                                     | Saw Timber.<br>Bd. ft. | Fuel Wood.<br>Cords. |
| Railway Belt and Yoho Park. . . . . | 600,000,000            | 6,000,000            |

*Summary.*

|                                    |                        |                      |
|------------------------------------|------------------------|----------------------|
|                                    | Saw Timber.<br>Bd. ft. | Fuel Wood.<br>Cords. |
| Manitoba Reserves. . . . .         | 602,933,000            | 6,250,000            |
| Saskatchewan Reserves. . . . .     | 55,000,000             | 690,000              |
| Alberta Reserves. . . . .          | 3,402,000,000          | 54,220,000           |
| British Columbia Reserves. . . . . | 600,000,000            | 6,000,000            |
| Total. . . . .                     | 4,659,933,000          | 67,160,000           |

## ESTIMATE OF ANNUAL OUTPUT.

The following table showing the quantities and kinds of timber taken from the reserves is also tentative as it is only an estimate. Heretofore, the quantities of timber cut on permits granted for the reserves have not been kept separate in the records from those granted for timber on other Dominion lands. It is the intention that in future forest reserve matters shall be kept by themselves so that accurate data in regard to them can be obtained. The receipts, however, as stated in the table, may be considered as correct. The figures may seem small considering the quantities of timber removed: but it should be borne in mind that every homesteader is entitled to one free permit.

## TIMBER CUT DURING YEAR ENDING MARCH 31, 1908.

| District.  | Lumber.<br>Ft. B.M. | Log.<br>Lineal ft. | Cordwo'd.<br>Cords. | Fence<br>Posts.<br>No. | Fence<br>Rails.<br>No. | Poles.<br>No. | Receipts. |
|--|---------------------|--------------------|---------------------|------------------------|------------------------|---------------|-----------|
|  |                     |                    |                     |                        |                        |               | \$        |
| Manitoba Reserves. . . . .                               | 3,789,180           | 17,134             | 3,647               | 31,100                 | 22,650                 | 8,250         | 7,044 41  |
| Saskatchewan Reserves. . . . .                           | 343,435             | 464,110            | 9,029               | 117,140                | 106,510                | 102,414       | 535 35    |
| Alberta Reserves . . . . .                               | 1,400               | 332,612            | 1,280               | 52,080                 | 247,155                | 48,265        | 56 75     |
| British Columbia Reserves. . . . .                       | 8,338,000           |                    | 2,500               |                        |                        |               | 4,794 00  |
| Eastern slope, north as far<br>as Brazean River. . . . . | 31,651,610          |                    | 56,037              | 336,860                | 1,336,700              |               | 19,325 00 |
| Totals . . . . .   | 44,123,625          | 813,856            | 72,493              | 737,180                | 1,713,015              | 158,929       | 31,755 51 |

Throwing these different kinds of material into saw timber and cordwood we have saw timber about 45,751,325 board feet; cordwood, 105,943 cords. Dividing these quantities into the quantities estimated as standing on the reserves we perceive that the saw timber should last for one hundred years, and the cordwood for six hundred and thirty-four years, practically for ever, providing that the rate of consumption remains the same and that no timber be destroyed by fires or other causes. To be sure the growth has not been taken into account, but it is reasonable to suppose that fires will at least offset the growth, be we ever so vigilant.



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Up to the present time permits have been granted only to actual settlers living within fifty miles of the nearest boundary of any reserve. This limitation is worthy of consideration. There is very little wood in southern Manitoba and scarcely any in Saskatchewan, and it is a question if the people all over these provinces should not be allowed the use of the mature wood of the forest reserve. It may not be quite justice to allow only the people living in the immediate vicinity of the reserves to have all the blessings.

It is a question also, if it is wise to allow only settlers to cut the timber. The average settler in taking out timber has little care for the future of the forest. His only object is to get out the timber he needs as easily as possible. If one tree has all the timber he requires, but if two will furnish it more easily, he will cut the two trees. Moreover, the settlers cut high stumps, leave large tops, and make no disposal of the brush. Millmen, knowing the loss in cutting high stumps and leaving large tops, and having regard for the future growth, treat the forest with much greater care. It therefore seems to me that mills should be permitted to enter the reserves, but they should enter under certain restrictions:—

- (1) Only portable mills should be permitted.
- (2) Mills should locate where the Forestry Branch directs.
- (3) Permits should be granted for a definite tract not more than one mile square.
- (4) Permits should be granted for one year only, but should be renewable at the discretion of the Superintendent of Forestry and should be cancellable at any time for violation of the regulations.
- (5) Only such timber should be cut as is marked previously by the department for removal, and no cutting should begin before the marking is completed.
- (6) In cutting down the trees the stumps left should not be more than 18 inches high.
- (7) The trees should be cut down with a saw.
- (8) All parts exceeding 4 inches in diameter of trees cut down should be removed by the permittee, and this should be done as the cutting progresses.
- (9) Brush should be cut so as to lie flat on the ground excepting along the roads where it should be piled and burned under the immediate supervision of the department.
- (10) Any unmarked trees cut down on account of the lodging of the larger trees in felling should be piled by themselves separately from the other logs, and should be considered the property of the department to be afterwards disposed of, either to the permittee or others as considered best.
- (11) The dues on timber removed should be the same as those demanded of settlers.
- (12) Lumber should be sold only to bona fide occupants of homesteads, or for the purpose of erecting churches and schools in rural districts.
- (13) Any lumber obtained from a permittee and afterwards sold or offered for sale should be seized by the department.
- (14) No settler should be permitted to receive from the mill in any one year more than 10,000 feet of lumber.
- (15) The price of lumber at the mill should be fixed periodically by the department.
- (16) Settlers should be permitted to draw out their lumber with their own teams.
- (17) Permittees should be required to keep a mill book in which should be recorded all sales, to whom made, quantity sold, and price charged.

The department has this scheme of treating the forest already under operation. A saw-mill operating in the Cypress hills was last fall put under such restrictions, partly as an experiment, and I am glad to be able to report that the experiment is apparently a success. The owner of this mill had applied for a tract of spruce timber

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three-fourths of a mile square. The department stated the restrictions. They were accepted. Assistant Inspector Dickson marked the trees to be cut, and the work of cutting began. The forest ranger of the Cypress Hills reserve, who has the work under his supervision, writing on January 22, 1909, reports as follows:—'I have been down to the Grayburn mill for a few days and was all through the bush where they are cutting. They are keeping very close to the marked trees. I told them to get the brush piled along the trails and to get the poles out and they promised to do so. I will go down again soon and burn it.'

#### THE RESERVES AS PLEASURE RESORTS.

There are many beautiful lakes on the forest reserves and some of these are being now freely used as summer resorts. It seems to me that this should be encouraged. The campers are not a menace to the forest, in fact they are a protection, as they have personal interest in guarding the forest against fire. Besides, with campers on the lakes when a fire occurs there are people at hand to help to extinguish it. Therefore, the advisability of renting camp sites on the shores of these lakes, the leases to be made out for ten years, renewable at the discretion of the superintendent of forestry, and cancellable at any time for any misuse or menace to the forest reserve, is under consideration.

Respectfully submitted,

A. KNECHTEL.

*Inspector of Forest Reserves.*

## APPENDIX No. 2.

### REPORT OF R. H. McMILLAN.

OTTAWA, March 31, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa.

SIR,—I have the honour to submit herewith my report of the work which I have carried on under your instructions since June 15, 1908.

I first undertook an examination of the Pines Forest reserve, an area of 145 square miles, a short distance southwest of the town of Prince Albert, Saskatchewan. The object of the examination was to discover to what extent the reserve had suffered from fire, how much timber there was remaining, how much young growth capable of producing timber, the character of the soil around the reserve and what steps should be taken to protect the reserve from fire and put it in the best shape for the production of timber to supply the needs of the farmers on the surrounding prairie.

Four men were employed, two of them forest students, and a detailed examination and survey were made of the whole reserve. A map has since been prepared showing the location of the mature timber, the young trees and prairie and of all the trails. Where timber representative of the region could be found, measurements were taken to learn the average growth rate of jackpine in northern Saskatchewan and to discover its suitability for the production of railroad ties. A brief summary of conditions governing on the Pines Forest reserve is given below.

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The Pines Forest reserve consists of an area of 145 square miles of sand ridges separated by muskegs. Where the land is sandy it is too light for agriculture. The sand is shown in railway cuts and at river banks to be in some instances 30 feet deep. If such land were cultivated it could not produce a crop, and when the sod and forest cover were removed it would be exposed to the forces of the wind and drifting sand dunes would be formed. Such land is now being artificially reforested at considerable expense by the Ontario government. There are small areas where the soil is a light sandy loam, but in such situations the drainage is so poor that a large proportion of the land is covered with muskegs and broken by sloughs. It is thus unfit for cultivation.

There is no doubt but that of the whole of the land within the reserve there is no quarter section but what is too uniformly broken by sand hills, ridges, sloughs, or muskegs to be suited for agriculture or capable of producing a living for a family, nor is the reserve sufficiently adapted for grazing to be thrown open for homesteads with that intention. Where sod exists it is very light and a large area would be required for the support of very few cattle. There are no natural hay meadows in the reserve, and the feed necessary to support stall-fed cattle through the winter would have to be grown on good land outside the reserve.

Around the immediate edge of the reserve there are settlers, most of them with very poor farms, who have depended largely upon the sale of cordwood from the reserve as a means of making a living. These people, together with a few cordwood dealers, who have profited by shipping wood to points south of the prairie, are the only ones at present interested in the sale of timber from the reserve. The majority of the people, those who are settled on the good agricultural land to the east and south of the reserve, are very much interested in having the cutting of wood limited to bona fide settlers. These farmers are at present dependent upon the Pines for building material, fencing and fuel, and they all believe that for the sake of the future, when increasing settlement will make timber still more valuable, the Pines Forest reserve should be protected from fire and managed so that it will perpetually produce timber for the use of the settlers.

Another class of people interested in the Pines Forest reserve as a source of timber supply are the residents in the prairie towns and communities farther to the south. The reserve is crossed by the railway and cordwood has been profitably shipped to Moosejaw and Regina and other towns on the prairie. Local demands must be considered first, and therefore it may not be possible from the small supply of timber now existing on the reserve, to permit the shipment of cordwood to distant points, but there is no doubt that in the future, when the whole area is under timber, there will be a surplus which can be made available for southern Saskatchewan.

Thirty years ago the greater part of the reserve was covered with dense stands of jackpine, spruce, tamarack and poplar. Altogether there were 38,400 acres of jackpine forest. Stumps and scattered trees still standing show that the average diameter over large areas was 8 to 12 inches, and that the maximum diameter was 24 inches. The contractors twenty years ago cut over a large area, taking only one tie from a tree. In the slash which they left fires were started from settlements and the railroads, and as a result there is not an acre left but has been burned over. The small patches of timber which were not completely destroyed by the fire have been gradually removed by tie contractors, cordwood shippers and the settlers. No timber now remains, excepting scattered patches of green and dead trees fit only for fuel. A detailed survey of the reserve showed that there were altogether only about 45,000 cords of fuel and of this nearly 15,000 had been killed by fire. There are about 37,000 cords cut per year from the reserve. This demand will in four years exhaust the supply of dead wood and will in ten years, with no extra consumption for building

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logs, and fencing, strip the reserve. It would therefore seem advisable that the remaining wood be kept for the supply of the surrounding people.

Fortunately the fire which has destroyed the mature timber has brought about conditions favourable for the growth of young timber. Jackpine, which is the tree best adapted to the light sandy soil of the Pines reserve, is a tree which is also well fitted for reclaiming burned over areas. The young pines begin to bear seed when about ten years old. The seed is encased in hard cones which hang on the tree for a number of years. The fire which destroys the timber does not always destroy the cones but only serves to open them up and liberate the seed. Jackpine seed germinates best on mineral soil where there is no shade or vegetation. These conditions are found after a forest fire and as a result a fire on jackpine land is nearly always followed by a very dense reproduction of young jackpine trees. There are now about 22,400 acres of the reserve densely covered with a thrifty growth of jackpine, varying in age from five to twenty years. Growth measurements taken of jackpine showed that at sixty years it reaches a height of 58 feet, a diameter of 11 inches at the stump and will make three ties or 32 feet of logs per tree. The young jackpine at present on the reserve will, if protected from fire, produce small fuel in ten years, and in twenty years from now will be large enough for poles and small logs.

There are on the reserve 40,000 acres of denuded land upon a portion of which there never was a forest, excepting small poplar and willow, and from the remainder of which repeated fires have removed both the original timber and any young reproduction that may have occurred. The denuded land is nearly all well suited to the growth of jackpine. A portion of it is gradually coming up with jackpine and poplar, and there is no doubt but that eventually it will all be reforested. It is probable, however, that it will be 75 or even 100 years before the whole of the denuded land is again covered with timber. It may therefore be advisable for the government to take some steps to encourage the artificial reproduction of timber on the tracts where natural reproduction seems least possible. The scheme which has been tried elsewhere with success is the sowing of seed on the snow in the winter. It seems that if jackpine seed were coated with red lead to protect it from birds and animals it could be sown broadcast upon the snow in winter and would with the melting of the snow be taken down to the soil under conditions most favourable for its germination. This method of artificial reproduction is very cheap.

The first necessity for the management of the reserve is efficient fire protection. The fire ranger should live on the reserve and should be a man who can easily secure the co-operation of the settlers in preventing and extinguishing fires.

The reserve boundaries do not at present follow the outlines of the sandy tract which the Pines Forest reserve represents. There are around the edge of the reserve several sections and quarter sections quite as unfit for agriculture as any of the lands within the reserve, some of them being very sandy, others for the greater part, covered with sloughs. This land can never be of any value to the country except by producing timber. An examination was made of all the land surrounding the reserve and such sections as are unfit for agriculture and are available were specially examined and reported upon, in order that they might be, if possible, added to the reserve, and the boundaries definitely defined.

So far as could be observed the cattle and horses which have been grazing on the reserve have done no damage, but have probably been of assistance in keeping down the grass and thus lessening the fire danger and giving seedlings a better chance to start. The grazing is of some value to the surrounding farmers, particularly those near the reserve, who have very poor land, and it would therefore seem advisable that they be allowed to secure, as cheaply as possible, grazing permits for their stock.

There has been game in the reserve, and at present moose, elk and deer are occasionally seen. There is absolutely no enforcement of the game law and as a

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result what little game remains will be very soon exterminated. This territory is very accessible and is a most convenient hunting ground for all the towns between Prince Albert and Regina. If the game were protected it would do much to popularize the reserve with those interested in sport.

## PRINCE ALBERT FOREST RESERVE.

Acting under your instructions I made an examination of the sandy tract north of the Saskatchewan river, a portion of which had previously been set aside as the Prince Albert Forest reserve, which originally covered only about 19 square miles, although the sandy ridge upon which it is situated extended both to the east and the west and covered about 200 square miles.

The object of the examination was to locate the land which even in consideration of its proximity to Prince Albert, its possible value for market gardening and poultry farming, would nevertheless be most profitably employed in the production of timber.

Provisional boundaries were established for an area of 214 square miles of sandy land unfit for agriculture, which it seems might be most profitably set aside as a forest reserve, with the possible exceptions of a few isolated quarter sections or sections upon which local soil conditions are such that a crop can be produced. Aside from such exceptions the whole area of 214 square miles is exactly similar in topography and soil conditions to the Pines Forest reserve already described. It is if anything more uniformly sandy. Forest fires have repeatedly run over the whole tract and very little mature timber for anything but cordwood now remains. The burnt over area is everywhere covered with a dense jackpine reproduction which will in 20 to 30 years be producing valuable fuel and small timber.

If the land is now thrown open for homestead some of it will be homesteaded by people who do not know that the soil is unfit for agriculture; some of it will be homesteaded by others who are anxious to get what scattered fuel there is and who will abandon the land. The result will be that no permanent profit will come from the use of the land. The young timber will be cut and destroyed by fire and there will eventually be, between the town of Prince Albert and the fertile land a few miles north, a worthless sandy waste across which it will be expensive to maintain roads and from which no profit can be derived. It has been proved in other countries and is now being demonstrated in Ontario, that no good can come from the settlement of sandy land, and that if such land is settled it almost inevitably reverts to the government after having been productive of two or three generations of hardship for its unfortunate owners. It is surely wiser and cheaper to keep such lands under forest cover than to be forced later to adopt expensive means of reforestation.

This area of approximately 200 square miles under forest management producing a perpetual crop of fuel, ties and timber could not fail to be a source of revenue as well as pleasure to the citizens of Prince Albert. Where coal is scarce, as it is in this region, a guarantee of a perpetual supply of cheap fuel might be a consideration which would induce small manufacturers to locate in the region.

The Canadian Northern Railway will this year start the construction of their Battleford line, a part of which traverses the timber area north of Prince Albert. It is very important that extra precautions be taken to prevent fires starting from the right of way.

## MOOSE MOUNTAIN FOREST RESERVE.

Acting under your instructions I visited the Moose Mountain Forest reserve to look into the question of making provision for permanent camping sites on the different lakes and to see what could be done to improve a few of the trails.

The Moose Mountain Forest reserve furnishes the only summer resort easy of access for people residing between Winnipeg and Moosejaw. Railway lines and trails

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which have lately been constructed have made trips to Moose mountain much more convenient. The camping season lasts from July 1 to September 1. During this time in the summer of 1908, 2,500 people are estimated to have visited the reserve for periods varying from one day to four weeks. By far the greater number go to Fish lake, which is the largest and most beautiful summer resort. Other lakes visited are Rocky lake, Gillis and Stevenson lakes within the reserve and White Bear lake in the White Bear Indian reserve. At the last mentioned lake the town of Carlyle has acquired a 99-year lease for camping purposes.

During the past year campers came to Moose mountain from the whole of Southern Saskatchewan, and from towns as far east as Brandon and Winnipeg. Some are picnickers who only wish to stay a few days and others are business men who wish to bring their families out for a month or two. The latter do not wish to tent amongst the underbrush and are anxious to secure somewhat permanent title to a small piece of land so that they may build cottages and beautify and make more convenient their surroundings. They are a class of people whom it would be advisable to interest in the reserve. They would be very ready to appreciate the great courtesy extended to them and very unlikely to do any damage by fire or otherwise.

The needs of the public could easily be provided for by reserving public camping grounds of considerable area on all important lakes or popular resorts by guarding against a monopoly of any point of interest or the obstruction of any trails. There would still remain large stretches of lake front suitable for camping purposes. These, if subdivided into small lots and leased for a term of years at a nominal rental, would enable permanent campers to build cottages and to assure themselves a summer home such as they desire. The adoption of this policy will do much to furnish the people of the prairie towns with pleasant and healthful places in which to spend their holidays, and will on the other hand be of great benefit in popularizing the forest reserves with the people. The presence of large numbers of campers in the reserve in the summer months will make available a very convenient fire fighting force.

The roads at present in the reserve are very wet and extremely hard to travel in June and July. This is an inconvenience to settlers around the reserve who are forced to cross it to avoid wide detours. It is a source of great loss of time to the fire rangers and makes it very difficult for campers who wish to drive out for a couple of days.

The bad state of the roads is due in part to their location on low land, and in part to the fact that they are so narrow the sun never gets at them to dry them. Mr. Rutherford, the forest ranger, went over them with me and together we made plans for the improvement of all the main trails, either by changing their location, widening them or building culverts.

Under the regulations which have permitted the removal of only the dead timber from the Moose mountains, the reserve has been so well cleaned up that at present there is only enough of such material to supply the demand for about one more season. There are, however, scattered in numerous patches, small areas of poplar the majority of which is steadily deteriorating. On account of the damage to which it has been subject from fire and fungi, the greater part of this wood is only fit for fuel. Practically all the mature timber in the reserve is of this class and, outside of a small strip along Fish lake which should be reserved for scenic purposes, all should be cut. It is not only becoming yearly of less value but is a source of infection, spreading the germs of the fungus destructive to poplar, and thus damaging the young growing stock. The reserve is so well stocked that none of the timber is required for seed trees and should be cut clean wherever cut. It would therefore seem that as soon as it is shown that all the available dead timber has been removed the regulations governing this reserve should be so altered that green timber could be cut. Before the season

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starts the ranger can select those areas upon which the stand of timber is in the worst condition and confine the cutting to such areas until everything is removed.

## BEAVER HILLS FOREST RESERVE.

Mr. Willing, the Provincial Game Guardian for Saskatchewan, informed me that his department had made an examination of township 27, range 10, west second meridian, lying immediately north of the Beaver Hills Forest reserve, in order to learn its suitability as a game reserve. As a result of the examination the Saskatchewan government desired to have the township added to the Beaver Hills Forest reserve, and constituted a game reserve, in order that they might place there the beaver which they contemplated removing from the Souris river and other streams in settled districts to the game reserve, where they would do less damage and be afforded more protection.

I therefore made an examination of township 27, range 10, and the surrounding country to learn its suitability as a forest reserve. This township is exactly similar in every respect, to the townships which already constitute the Beaver Hills Forest reserve. It consists of rolling land broken by large numbers of sloughs which are the only drainage channels, which stretch almost impassably in every direction and cover about one-quarter of the total area. There are hardly any well defined streams, and those which exist have been so dammed up by beaver as to form ponds.

The soil is a heavy, impervious clay covered with very little humus or loam. It is free from boulders and gravel excepting on the ridges and knolls.

The whole area, together with four or five of the townships surrounding, forms the watershed for many small streams flowing out through the prairie country. Surrounding the hills about eight townships, of which the three townships under discussion form the centre, were originally heavily timbered with poplar. Prairie fires and fires starting from the settlements have destroyed all the timber and at present there are only small clumps of poplar left, and the whole of the remainder of the area is covered with young poplar, grass and peavine.

In spite of the fact that it will always remain quite a distance from the railroad and that it can never be well drained, a portion of the land has been homesteaded. The difficulties of the settlers have been numerous. Wherever a few acres have been broken crops have been unsuccessful every year. The land produces a very light crop of grain and almost regularly, probably on account of the elevation and the cold, wet soil, early frosts kill the crops. The peavine and rich grass furnish splendid grazing. The country is more suited for the production of cattle than of crops.

There is no doubt but that if the land is protected from fire it will rapidly produce dense stands of poplar timber. There is no other source of timber suitable for the use of the settlers within 75 miles of this region. Within this radius the land is more suited for agriculture than are the Beaver hills, is more accessible by railroad and will soon be under settlement. The necessity for preserving a public timber supply in the midst of this prairie region, together with the fact that agriculture is not a success on these hills, should furnish sufficient reason for the protection of timber in the available land in the townships reported upon.

Many of the settlers who have met with nothing but failure for two or three years are on the point of abandoning their homesteads. The settlers on the good land of the prairie are anxious that the Beaver Hills Forest reserve be extended to include as much of the sloughy district as possible.

The greatest need of this reserve at present is fire protection and game protection. There has been no fire guardian, and as a result fires have been very frequent and have every year destroyed large quantities of timber. The game regulations have not been enforced and the small quantity of game remaining is being rapidly exterminated.

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## KOOTENAY LAKES FOREST RESERVE.

In September I made an examination of the district surrounding the Kootenay Lakes Forest reserve to report on its suitability for a national park.

The federal government of the United States has lately set aside as a national park and perpetual reserve for the more valuable species of big game an area of 1,400 square miles, comprising the summits of the water sheds of the Flathead, Milk, St. Mary and Belly rivers in Montana. This reserve will be known as the Glacier National Park. It includes about 60 glaciers, a large number of lakes and streams, and a mountain region of unparalleled grandeur, in which there are numerous peaks ranging from 6,000 to above 10,000 feet in altitude. The park will always be a very popular resort for travellers and tourists. It is the home of mountain goats, mountain sheep, bears, deer, elk and moose, and will be a breeding ground from which they may scatter into country where they will furnish good sport and yet will not be exterminated.

The object of my examination was to discover if there was a similar area on the eastern slope of the Rockies in Alberta which could be set aside as a national park and as a refuge for game on the Canadian side of the boundary line.

The time at my disposal prevented me from continuing my examination further north than the drainage basin of the Waterton river south of Newman's peak and west of Belly river. I covered a territory of 191½ square miles, a brief description of which is given below.

The late Dr. G. M. Dawson, in his report on the geological and physical features of the Rocky mountains, stated that the scenery in the vicinity of the Kootenay lakes was not excelled in grandeur by that in any other part of the mountains. Although the Canadian peaks are not as high as the peaks in the Glacier National Park and although there are no glaciers, the area is probably more suited as a national park for camping purposes than it would if it were more rugged. The Waterton lakes, closely surrounded by the mountains, furnish wonderful opportunities for boating, fishing and camping. Within easy access from the lakes are several beautiful valleys and many rugged mountains, from which a view may be obtained of the snow and ice-capped summits of the Flathead range in Montana. The most beautiful and the most rugged Alpine scenery is undoubtedly in the Glacier National Park of the United States, but the best place from which to visit the Glacier National Park and the most pleasing camping places which can be selected as headquarters from which to make pack trips into the mountains are found within the Kootenay Lakes Forest reserve and the territory embraced in my report.

The mountains surrounding the Kootenay lakes are frequented by the big horn sheep, mountain goats, black and grizzly bears. There are also found here the Rocky mountain grouse, ptarmigan and the prairie chicken. The lakes themselves and the streams flowing into them abound in lake and brook trout. The region is so accessible that both game and fish are at present in danger of being exterminated. If the game is protected on the United States side and not on the Canadian, it will only be a matter of a few years until the animals retreat to the mountains of the Glacier National Park, where they will be inaccessible to Canadian sportsman.

Forest fires have killed all the timber within the territory described. There is, however, a thrifty young growth of lodgepole pine which will before many years cover the region and furnish timber.

The country can be of no value for agriculture, and what little grazing there is can be made available to the settlers of the Foot hills even if the territory is reserved.

The discovery of indications of oil along some of the streams has led to extensive drilling operations in the hopes of developing oil wells. Up to the present no paying quantities of oil have been discovered and the several companies interested have to



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all appearances abandoned the search. They have left trails which render the territory more accessible.

This district affords the best summer resort available to the people of southwestern Alberta. It is annually visited by increasing numbers from Macleod, Lethbridge, Carlston and the intervening towns. If it is made into a national park or forest reserve no industry will be adversely affected and the people of southern Alberta will have assurance that such a park, which is the entrance to one of the most noted mountain regions of the Rockies, will be given efficient fire and game protection, and will remain always one of the best summer resorts for the people of the province.

The game protection in this region is at present inadequate. Parties have been known to take out as many as 500 trout in one afternoon and the streams are being rapidly depleted. There is no fire ranger in the district. Although there is no mature timber the value of the young timber is such that care should be taken to protect it from destruction.

## THE CROWSNEST PASS, ALBERTA.

The coal mines of the Crowsnest Pass, Alberta, are even now, in the early stages of their development, experiencing some difficulty in securing a supply of the timbers necessary for the carrying on of their operations. In order to learn just what the situation was I spent a month in the Crowsnest valley studying the timber requirements of the mines in operation, the possibilities of securing timber locally, the quantity of timber available for mining purposes and endeavouring to find out just what steps should be taken by the Forestry Branch to improve the situation. Chief Forest Ranger Margach, who is thoroughly acquainted with all the details, went down to the Crowsnest Pass with me and spent some time in helping me to get acquainted with the country.

In connection with the report which I submitted I prepared a map of the region showing the area of green timber remaining unburned, the areas of the standing dead timber, of the young timber and of the burned over land upon which there are no trees.

The Crowsnest valley affords a good example of what fire has done to the timber of the eastern slope of the Rocky mountains. Of the 240 square miles included in the valley, 212 were originally covered with a fairly dense forest of spruce, pine, Douglas fir and balsam. At present only 33 square miles remain unburned, 179 square miles having been burned over. Of this latter area 60 square miles are covered with young growth, 34 square miles with dead standing timber, and 85 square miles have been so badly burned and so frequently, that only a few scattered trees remain. It must be a very long time before another forest can be produced.

The 33 square miles of green timber remaining is practically all held under license. The total stand is about 126,000,000 feet. The yearly cut is about 5,000,000 feet and is annually increasing. Twenty years probably will see the last of the present stand of mature timber in the Crowsnest valley.

The mines at present operating in the Crowsnest Pass require annually about 3,000,000 lineal feet of props and ties, and about 2,500,000 board feet of lumber and dimension timber. The props and ties require to be light and strong and are made of round timber 4 inches to 8 inches in diameter at the top. The dead timber standing after the fires of five and fourteen years ago is very suitable for this purpose. There are in the Crowsnest valley about 24,000,000 lineal feet of such timber, a supply which will be sufficient for about eight years. About three-quarters of this dead prop timber is in the hands of the timber limit holders and, under present conditions of sale, costs the mine owner more than similar prop timber purchased in Montana and British Columbia.

The young timber, which is now generally supposed to be of very little importance, will in a few years be the only source of props for the mines of the Crowsnest

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Pass. There are about 60 square miles which after being burned over have come up densely to lodgepole pine. Measurements taken of the growth of timber in the Crowsnest Pass show that lodgepole pine produces prop timber at thirty years of age, but that the most profitable period at which to cut it for mining props is at sixty years. Pine will then produce about 620 8-foot props per acre. The measurements taken of the growth rate of spruce and fir, the timber which will have to be depended upon for a supply of lumber, show that spruce reaches a diameter of 12 inches in 90 years and fir reaches the same diameter in 110 years. The young growth is now 5 to 14 years old, consequently it will be producing mining props in 15 years and lumber in from 75 to 95 years.

Granting that the pine produces 620 props per acre at sixty years of age, and that the requirements of the southern Alberta coal field for 1913 are only 5,500,000 lineal feet of props, it will take 66,000 acres of pine to produce a continuous supply of props. The mines must have an assured supply of props and there are 66,000 acres of territory, immediately surrounding the mines, fit for nothing else than the growing of props.

The denuded area, 85 square miles in all, upon which there are no, or very few trees lies mostly in the valley bottoms and on the lower slope. Excepting for small meadows along the streams, the soil is a sterile gravel covered with thin dry sod. The market conditions are such that where there is a fair soil and good grazing, a comfortable living can be made by growing produce for the mines. All the locations upon which this is possible have been homesteaded. The remainder of the denuded area, nearly the whole of it, is unfit for anything but the growing of trees. If it is protected from fire it will gradually seed up. Before natural reproduction has covered the whole area with forest growth, it may be advisable to hasten the process by employing such methods of seeding as were discussed for the Pines Forest reserve.

It is very important that a forest should be maintained on the eastern slope of the Rocky mountains. The settlement of the prairie is creating a constantly increasing demand for lumber and the cheapest lumber on the southern prairie will always be that cut on the eastern slope.

Cheap mining timber is necessary for the production of cheap coal, and lumber and mining timber are the only crops possible from the greater part of the eastern slope.

The watershed of the eastern slope supplies 98 per cent of the water on the prairies. According to the highest authorities the forest on a watershed modifies violent stream fluctuation and thus prevents damage to irrigation ditches and makes available a larger supply of water during the irrigation season.

Maintaining a forest on the eastern slope does not mean an annual expense, beyond that necessary for fire protection. Unless there is fire protection there can never be any public or private revenue from the land and if there is fire protection there will always be both public revenue and private profit from the timber that will be naturally produced on land unfit for anything else.

The present system of fire ranging has been as efficient as was possible with the money at the disposal of the department. The greatest losses from fire occurred before the present system was inaugurated. The increasing value of the young timber, the increasing danger of forest fires arising from the development of coal mines, and the advance of settlement, render it necessary that more attention be devoted to the protection of the eastern slope forests from fire. If a larger force is employed on the eastern slope, as should be done, it will be necessary, in order to secure the most efficient service, to have some one in charge whose duties do not require him to leave the territory during the fire season, and who can devote all of his time to the administration and supervision of the work. The present chief ranger, Mr. Margach, has done good work by securing the co-operation of the limit holders and the mine owners,

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but he has been severely handicapped by other departmental duties which have required his absence from the territory.

Under the present regulations all, or nearly all, trees under 10 inches in diameter are left. Almost inevitably these are destroyed by fire or wind and the timber is lost. The loss per square mile through trees thus left is about 200,000 lineal feet of mining props and 190,000 feet, board measure, of lumber.

The idea in leaving these trees is presumably in order that they may grow to a larger size for a subsequent cutting or that they may seed up the ground. Neither of these objects is served in this particular locality. The trees are so scattered that if they are not burned they blow down or are killed by the sun which gets in and dries the soil, nor is good natural reproduction secured because the trees are left. Where the timber is all removed the cones which are left on the ground supply just as good reproduction of jackpine as is secured where seed trees are left standing.

There is a waste in logging operations in the Crownsnest Pass which seems unnecessary where the timber is so accessible and so valuable. There are left in high stumps, long tops, rollways and lodged trees, timber which brings the total loss per square mile up to 360,000 lineal feet of mining props and 400,000 feet, board measure, of lumber.

This lumber is accessible and should be taken out. In order to conserve a supply which is not too great and to secure for the government a revenue which is otherwise lost, the lumbermen should be encouraged to take it out. The governments of Quebec and the United States are, by increasing the dues on merchantable timber left in the woods, encouraging the lumbermen to remove everything that can profitably be removed. The result of such a policy is a larger production of lumber from the limits, less danger from fire and better prospects of a future crop.

Wherever it is possible for a family by industry and intelligence to make a living on a quarter section they should be encouraged to do so, but in a mining district like this, where there are very few locations where profitable homesteading is possible, care should be taken that no land is thrown open for homesteading that is unfit for agriculture, or ranching. There are always people who are ready to enter for a homestead even if there are only 25 acres of land on it, so long as there is a chance to make a living for a few months by selling what little timber there may be in the neighbourhood.

Homesteads in the mountains would be made more valuable and those owning them would be able to make a better living if the law were changed so that homesteads could be entered by legal subdivisions instead of by quarter sections. The meadows are almost the only sites suitable for homesteading. They are often so badly cut by the survey that a meadow only covering an area of 150 acres may be divided amongst three or four quarter sections. It is thus unavailable for any one family, whereas if it could be described and entered by legal subdivisions to the extent of 160 acres, the whole of it might be made available for one homestead and might be made a valuable property.

It would meet with the wishes of mine owners if all the land unfit for agriculture could be retained by the government to provide a perpetual supply of mining timber to be made available upon fair terms whenever it might be needed. The adoption of this policy would mean that no land unsuited for agriculture should be homesteaded; that the timber limits, as fast as they are cut over or burned over so as to be valueless for the present production of timber, should revert to the government, and that the whole territory be given efficient fire protection.

North and south from the Crownsnest Pass on the eastern slope of the Rockies, are similar areas about which there is very little definite information. It would seem advisable that a reconnaissance survey should be made of districts so important for their timber and water supplies in order that definite information concerning local

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conditions might be obtained, and that a general plan might be outlined for the fire protection and management of the whole area.

## STATISTICAL WORK.

With your permission I have discussed with Mr. Kellogg, Associate Forester of the United States Forest Service, methods of organizing an annual census of forest products in Canada, and I hope to be able, beginning with 1908, to secure complete data upon the consumption and production of all different forest productions of the country. It is likely that the publication of such information will do much to point out the necessity for provincial and national forest protection and regulation.

Your obedient servant,

H. R. MacMILLAN.

## APPENDIX No. 3.

## GENERAL REPORT FOR 1908 OF J. R. DICKSON, ASSISTANT INSPECTOR OF FOREST RESERVES.

OTTAWA, March 25, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa.

SIR,—I beg to present the following report for the season of 1908 :—

On June 1 orders reached me to take charge of a forest survey in the Riding Mountain reserve. A party of ten started in at the village of Ochre river on June 12 and proceeded up the Ochre trail to Clear lake, about forty miles, working the country on both sides. At that point we joined up with the 1906 survey, and crossing the Strathelair trail passed west through the Galician settlements bordering the south boundary of the reserve. As we moved along, three sub-camps were placed well into the reserve. Then entering the Birdtail valley I went northwest with a party of four over the Russell, Indian, Fisher and Gambler trails, completing in that way, by aid of a couple of pony trips made later south of Gilbert plains, a rapid reconnaissance survey of almost the entire 'West End.' The average number of student assistants throughout the season, was eight, and during the four months of field work we placed twelve main camps and four sub-camps. On October 16, the survey broke up and the outfit was stored at Grandview.

## OBJECTS SOUGHT.

In order to decide on even a simple plan of management for any forest area, it is necessary to know its conditions of soil and climate and the general nature of the country; to survey the trails and locate the main forest types; to find out the area and quality of mature timber for immediate cutting and the nature and quantity of young growth, the basis for future crops. Finally there are large portions of burnt

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over and prairie lands, the area and location of which must be known before any re-forestation is attempted, and in connection with this work, a study of habits, growth rate and relative commercial and local utility of the various species available is necessary, before deciding which to favour and propagate under future plans. As in previous years, therefore, the object of the work was necessarily general in its scope, namely, to take stock of existing resources and make a study of all the conditions and factors that will influence future management.

Owing to the nature and object of the survey the area covered can only be given as an approximate figure. In whole or in part thirty townships were traversed, about 660 square miles being mapped and studied and the important trails surveyed. Of this area, 115 sections lay in the east end and 545 in the west end.

Along the Ochre trail, where there is still considerable timber, valuation survey methods were followed as in former years, but in the west end, which has been largely fire-swept, taking notes and making maps was the important work. The more important trails were surveyed and plotted as the party advanced.

The season of 1908 left little to be desired from a field work standpoint. It was so dry that many trails were available which in 1907 were entirely impassable. This not only made transportation easy but allowed the field parties to be almost constantly at work.

A sketch of the work already done in the Riding mountains by the Forestry Branch, also the general conditions prevailing, and the necessary requirements of the provisional plan of management appear in a recent bulletin on the subject. The following is a brief summary:—

## FIELD WORK DONE.

During the past three seasons' work on this reserve, 1,170 square miles have been studied and mapped with that degree of completeness which the value of the timber or other conditions appeared to justify, leaving therefore 365 square miles scattered through the reserve upon which forest survey work has not been done, although on at least half of this area we have a fair knowledge of prevailing conditions.

The purpose of a working plan report for a forested area is to set forth clearly yet briefly all the facts and conditions affecting such timber tract likely in any way to prove useful or necessary in the work of laying down plans for its future management.

The Riding Mountain Forest reserve comprises 1,535 square miles of rough mountainous country in west central Manitoba. It is of great importance because of its being one of the largest of the federal timber reserves and situated in the midst of a populous community whose demand for its products has already reached large proportions. The land surface consists of two rolling plateaus some 400 and 900 feet respectively above the Dauphin plains. This entire range of hills being purely of glacial origin, the soils vary from gravels and light sandy loams to the heaviest boulder clays.

## FOREST TYPES AND PRESENT TIMBER CONDITIONS.

The timber over the whole area has suffered to such an extent by fire and disease that there is comparatively little first-class saw material left. The west half of the reserve was largely swept by two great fires some 20 years ago, but a good growth of young poplar now occupies the ground. There are still several small areas of good spruce and jackpine in the east end, but most of the timber there remaining is mature poplar, which is very defective. As white spruce is the most valuable and rapidly

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growing timber tree of the region it should be favoured over all others in future logging and reforestation operations.

The following estimate of the saw material on the reserve is based on the knowledge obtained during the past three years, and includes the timber 8 inches and over at breast height :—

| Species.                  | Board Feet. | Per Cent. |
|---------------------------|-------------|-----------|
| Aspen poplar.....         | 85,350,143  | 41        |
| Balm (Balsam poplar)..... | 27,032,691  | 13        |
| White spruce.....         | 42,135,088  | 20        |
| Jackpine.....             | 11,267,500  | 5         |
| White birch.....          | 15,172,356  | 7         |
| Larch.....                | 9,135,096   | 4         |
| Black spruce.....         | 17,006,112  | 8         |
| Balsam fir.....           | 3,328,000   | 1.5       |
| Total.....                | 210,740,347 | 99.5      |

(Other species, .5 per cent.)

#### AREA DISTRIBUTION OF RIDING MOUNTAIN FOREST RESERVE— APPROXIMATE STATEMENT.

| —                            | Acres.  | —                                  |
|------------------------------|---------|------------------------------------|
| Water.....                   | 95,000  | 25 per cent carrying pole stuff.   |
| Swamp and muskeg.....        | 140,800 | 80 per cent carrying reproduction. |
| Brule.....                   | 369,600 |                                    |
| Semi-brule.....              | 51,608  |                                    |
| Prairie to semi-prairie..... | 104,073 |                                    |
| Timbered.....                | 221,319 |                                    |
| Total area.....              | 982,400 |                                    |

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## CORDWOOD IN SAPLINGS ON RIDING MOUNTAIN FOREST RESERVE.

| Cordwood.   | Muskeg Type.                 | Cords,<br>87,480. | Per acre,<br>2.5 Cords. |
|---|------------------------------|-------------------|-------------------------|
| Basis—All trees 4 in. to 7 in. taken at 5 cubic ft. per mean sample tree (which is 6 in. D. B. H.). | Jackpine . . . . .           | 27,955            | 4.8                     |
|   | Green poplar . . . . .       | 134,111           | 2.4                     |
|   | Over-mature poplar . . . . . | 48,576            | 3.0                     |
|   | White spruce . . . . .       | 72,098            | 6.7                     |
|   | Mixed type . . . . .         | 316,160           | 3.8                     |
|   | Semi-brule poplar . . . . .  | 55,328            | 1.9                     |
|   | Total . . . . .              |                   | 741,708                 |

## MARKET AND LUMBERING CONDITIONS.

During the last ten days of October I made under your direction a study of permits in the Dauphin land office, and a report on the same was duly sent in. The number of permits issued in this land district fluctuates widely from year to year, but on the whole, 90 per cent of those granted on the reserves are in the Riding mountains, clearly proving this reserve to be at present easily the most important one in the province of Manitoba. A study of the markets and lumbering conditions about the reserve with special regard to aspen was also made at this time. Several of the large mills were visited and the owners interviewed. Up to the present, so far as I could learn, there has been no such thing as commercial poplar lumbering attempted on a large or small scale, in any part of the Riding mountains. The large mills may saw a good poplar log now and again but they only figure on the spruce log run, while the small millmen, who have no limits, are prevented by regulations from extending their operations beyond the farmers' permits. It was the decided opinion of every lumberman seen, that poplar lumbering will not pay under existing conditions.

Poplar has as yet no recognized place in the general lumber markets of the west. Poplar prices are not quoted in Winnipeg, and even in the Dauphin district one seldom finds any poplar in the local lumber yards. There is no available market as yet to which Riding mountain poplar could be shipped in commercial quantities. All the surplus spruce cut on limits in this district goes west over the Canadian Northern Railway lines to find a ready market in Kamsack and other prairie towns. Doubtless also if poplar lumber were properly seasoned and graded, in quantity sufficient for the trade, a profitable market could be created, especially for flooring and box material, but this will not occur while spruce lumber remains at present prices.

The forest of the lower plateau consists for the most part of aspen and balm poplar, with in places a large inclusion of paper birch, and in the ravines a scattering of elm, oak, ash and maple. On the upper plateau poplar is still predominant, but the forest is much more mixed in character, more or less coniferous growth being everywhere present, with considerable areas given over almost wholly to spruce, larch and balsam, or, in the drier parts, to jackpine.

Soil moisture determines three main permanent forest types: larch on the swampy areas, white spruce on the fresh to moist loams and jackpine on the dry sandy soils. But, as stated above, fire types, such as poplar and birch everywhere intervene. Owing

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to the slashed, diseased and burned conditions of the stands of timber on this reserve the annual balance between growth and decay is very difficult to estimate. We know, however, that the former exceeds the latter by at least 25,000 cords.

The population about the reserve, while mixed, is largely of British origin, and will be quick to recognize and approve all common sense measures looking toward its greater utility and improvement.

The market, owing to the nature of the merchantable timber, will be a local one and farmers' one in the main. A study of the market situation as affecting lumbering methods was made in October, several of the prominent lumbermen of the district being interviewed. They cut only spruce and a little larch, there being absolutely no market for poplar in commercial quantities.

#### DANGER TO THE FOREST.

Fire, fungi, insects, wind and frost have all been more or less destructive. Fire especially has swept away millions of dollars' worth of timber within the last 25 years, while the ravages of the hoof fungus have made large areas of standing poplar hardly worth lumbering.

To protect the timber from fire and trespass, there is now a staff on this reserve consisting of a chief fire ranger and four assistants, who have done much good work during the past two years. But more men are urgently needed for its proper safeguarding and administration.

#### PROVISIONAL PLAN OF MANAGEMENT.

The aim of all suggestions made or methods outlined in this provisional plan is simply to introduce a more far-sighted management of the resources on this reserve than has hitherto been attempted. Clearly, in advance of any actual regulation in a technical sense, an initial period of upbuilding and restoration will be necessary, for only after the present abnormal forest conditions have been reduced to something like normal, will it be possible with any accuracy to predict future returns or prepare a practical working plan based on annual production. The main objects now are :

(1) To provide for the wise and generous use of existing timber to meet settlers' requirements and popularize the reserve.

(2) To select and apply that silvicultural method best adapted to meet local future requirements.

(3) To introduce the best systems for protecting and administering the reserve.

The basic requirements of the situation are :

(a) To assure and convince public opinion that there is real utility and benefit to be gained by maintaining this reserve, the source of their supply of wood and water.

(b) To make the use of all the reserve products as ample and easy as possible, thus winning the confidence and support of every settler.

(c) To direct all cutting and refuse disposal in the woods with the object of securing a permanent and increasing yield in the forest.

(d) A full recognition of the enormous past losses and present dangers from fire, and the steps necessary to overcome it.

(e) To build up a more efficient and useful ranger service by a recognition of duties and functions, and the securing of a better-trained and more mobile personnel, devoting all their time and energies to government business. Along with this advance in methods of actual field work, the local office end of reserve management must also be made adequate to give complete control of the hay and timber sales business ; the receipt and filing of all permit records and reports, and cheerful, prompt consideration of all public correspondence and inquiry.



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(f) To consider where and in how far the work of reforestation should be prosecuted, and whether, considering the limited funds available, serious danger of fires and crude protective service justify such efforts at the present time.

(g) To carry on all improvement work on the reserve according to a definite plan. For instance, the whole ultimate system of trails, bridges, ranger stations, nurseries, compartments, &c., should be projected and mapped as soon as the available data bearing on these points will justify. Then all future work of the rangers is directed toward the fulfilment of this scheme.

## MARKING TIMBER IN THE CYPRESS HILLS.

From November 20 to December 22 I was engaged in remarking the boundary lines of a small timber berth in the Cypress hills, Alberta, and stamping according to government regulations all the trees to be cut thereon.

All trees above a certain designated diameter at breast height, or  $4\frac{1}{2}$  feet from the ground, were to be distinctly marked for removal. This 'diameter cutting limit,' as it is called, is fixed in this case at 10 inches. To measure all doubtful trees a pair of calipers is necessary, and to ensure that only the desired trees shall be cut, some distinctive stamp must be used. The first marking hammer tried was found of little use, being a log-end stamp and not suited for bark. To use it, the services of a boy were required to first remove the rough bark with a hatchet. Later a stamping hatchet was tried, which instead of the three small letters 'D.F.R.' had one large 'F.' on the back. This combination dispensed with the boy, but it is not distinctive enough, as with an ordinary cold chisel the stamp can be easily and quickly duplicated.

The above experience has shown, therefore, just what sort of tool is required to properly mark the trees most cheaply and easily, a 3-pound, east steel hatchet with a simple but distinctive stamp on the back.

*Marking in Different Species.*

If marking is to be a practical operation, the problem of securing the results it aims at in the cheapest possible way, must be the forester's chief study. Such being the case, his methods vary with different species, and in a general way the following principle will hold good. With tolerant species, such as spruce, hemlock or even white pine, those which form uneven-aged stands, the trees *to be moved* should be marked, while in the case of intolerant species, which form even-aged stands, like the jackpines and poplars, the trees *to be left* should be marked, whether the latter are scattered seed trees, or the boundary trees of a cutting area.

*The Work of Marking.*

In the Cypress hills case, the arbitrary diameter limit was strictly held to, all doubtful trees being calipered both ways and averaged to a tenth of an inch. That is, if 9.5 inches in diameter they were left, but a diameter of 9.6 inches placed them in the ten-inch class and they were marked for removal. To make mere size the sole criterion, however, is not the best policy; it is not flexible enough. To secure the best results the forester must be allowed discretionary power. Such exercise of judgment is necessary for various reasons, viz., where one or two trees in a vigorous clump of spruce are just over the diameter limit, as often happens, and to cut these out means destruction to the rest, the forester would not mark them, but leave the whole intact for the sake of enhanced future profits. It would be good business, good silviculture and therefore good forestry. Again, on a hillside where rigid adherence to the cutting limit would result in disastrous windfall, the forester should be empowered to use his judgment in raising that limit enough to prevent such a result.

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The forester could overcome cases also where an insufficient growing stock would be left to form the next crop if permitted to reserve a few seed trees above the cutting diameter limit.

Finally, he could do the work more quickly and cheaply.

#### *Cost of the Work.*

The cost varies widely with varying conditions and the thoroughness with which it is done. Where the trees are limbed to the ground, and the country is very rough, one can only mark from 300 to 500 trees per day, especially those short days of early winter when this work is usually done. In the Cypress hills work, besides the above difficulties there was also a ragged debris over the most of the area, and the labour of climbing through and over this reduced the above figures down to about 250 trees per day on the average. Of course, the trees were calipered and each one blazed and stamped twice, once below stump height, once above. The cost of such work is very high and would make it impossible to the average lumberman. But as an experiment and because of the peculiar conditions in the Cypress hills the government undertook it.

In an ordinary virgin spruce stand in rolling country where a man could stamp 600 trees per day, the relative cost would be very much less, and if judgment were substituted for the calipers, and each tree marked only once instead of twice, all the benefits possible could be obtained at a comparatively trifling expense. Where one-foot stumps are required by the regulations, it seems to me that one stamp below stump height on each tree meets every requirement. If the snow is so deep that the mark cannot be found with comparative ease it will be quite too deep for getting one-foot stumps. And this truth will apply just as well of course to any other height of stump. Moreover, the upper mark is of no value as a check on the work, for when the logs are piled in the mill-yard only one in a hundred of these marks can be seen. That is to say, the stump will secure every object sought for, and the resultant saving of time will make the work very much cheaper.

The method of work which proved most rapid was to carry back and forth across the area a strip approximately one chain wide, and mark all trees on the same side. For instance, if work were begun on the west border of the tract, all trees would be marked on the east side. This little point is important, because it enables one, while working alone, to cover ground rapidly and not miss any trees, a compass being quite unnecessary.

Granting, then, that a forester being paid \$6 a day, marks 600 trees, in timber which runs five trees to the thousand feet, board measure, we find the cost of such marking to be five cents per M.

#### CONCLUSION

(a) It is absolutely necessary in those parts of the west where the low rainfall and strong dry winds give a high evaporation co-efficient, with its concomitant, poor conditions for natural reproduction, that in spruce woods at least every tree be marked before cutting begins.

(b) The ten-inch cutting limit chosen for this tract proved to be just right, as it secured all the good merchantable timber while leaving the thrifty young trees of rapid taper and growth and not opening up the stand enough for the destructive entrance of wind.

(c) So inexpensive and yet of such immense practical utility is good marking as a means of perpetuating spruce forests (provided the presence of balsam does not render that result all but impossible), that it would seem to offer a very legitimate and promising field in the immediate future, for co-operation between the government and

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those lumbermen who, while anxious to operate conservatively, do not feel that their interests are extensive enough to justify the engagement of a forester.

In connection with this lumbering job at least two essential conditions for good work were made very clear :

(1) The necessity of having all parts of such an operation proceed simultaneously, thus leaving the work completed as it progresses.

Where the permittee lets all the work to a contractor who in turn sublets it to others there is grave danger of losing proper control. For instance, if the brush is not disposed of at time of lopping, it becomes so bound together by the skidding or partially buried by subsequent snowfall that it must be left *in situ* till spring, and to remedy the mistake then entails additional expense and friction to all parties.

(2) Advisory inspection while the work is under way.—This is because careful conservative methods of logging in Canada are as yet mostly in the educational stage, and mere rules carry little weight with lumberjacks and logging bosses, unless an official is on the ground to explain and enforce them.

As for the perennial problem of brush disposal, it can at least be said that no general solution of uniform applicability is possible; the question is in each case an open and relative one. Due consideration must be given to the fire danger, the best conditions for reproduction, and the cost. In the Cypress hills, where securing moisture for the desirable spruce seedling is the important factor, thorough scattering of the brush away from the logging roads and the burning of that which is piled up alongside them secure this main object in a large measure while also reducing the fire danger by changing the trails to fire lines, the whole being done at moderate cost.

Respectfully submitted,

J. R. DICKSON,

*Asst. Inspector Forest Reserves.*

## APPENDIX No. 4.

## REPORT OF C. A. WALKINSHAW, FOREST RANGER.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS AND CROWN TIMBER OFFICE,

BOISSEVAIN, MANITOBA, March 27, 1909.

R. H. CAMPBELL, Esq.,

Superintendent of Forestry,

Ottawa, Ont.

SIR,—I beg to submit herewith my annual report in regard to the conditions in the Turtle Mountain Timber reserve for the past year.

In the first place, I am sorry to say that we had bad fires in the reserve last spring. Owing to the dry and hot weather accompanied with high winds, it was impossible to get them under control, and although my assistants and myself worked day and night, the result was that a large part of the reserve was burned over, which was duly reported to you.

When all danger from fire was over, Mr. Knechtel, Inspector of Forest Reserves, supplied me with pine and spruce seed and instructed Mr. Thomas Scott, my assistant, and myself how and where to plant them. I went strictly by instructions, and when

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Mr. Knechtel and I inspected them late in the fall, we found that all of those planted in the grass had germinated, looking healthy and strong, especially the bull pine. Unfortunately, a large percentage of the seed planted amongst the young trees had been eaten by mice or birds.

I am satisfied that if that had not happened at least ninety per cent of the seed planted would have germinated.

I hope that the department will supply me with a large amount of seed this spring, so that I may be enabled to reforest a good part of the reserve that was burned over.

I may say that all the squatters have left the reserve with the exception of Mulholland and Maddess. They were ordered by the county court judge last fall to leave the reserve not later than April 1, 1909. I communicated with Mr. George Paterson, of Deloraine, who represents the Department of Justice in this case, asking him to see that the judge's order was obeyed. He answered me assuring me that it would be put into effect.

As instructed by Mr. Knechtel, Mr. Scott and I staked out the international line between Dakota and Manitoba, the southern boundary of the reserve. I found this a very difficult job, especially finding the mounds, owing to the rank growth of young trees and other vegetation.

I was pleased to receive a letter during the summer from Mr. Thompson, Professor in the School of Forestry at Bottineau, North Dakota, requesting information regarding protecting Turtle mountain from fires. I gave him all the information I could; I also visited him at Bottineau. He assured me they would do everything in their power to assist us in preserving Turtle mountain against fires. He also gave me a copy of a bill that he had presented to the legislature of North Dakota in the interest of fire protection. I mailed the copy to Mr. Knechtel at Ottawa, along with a request to assist in having it passed.

There have been issued during the past winter permits for over two thousand cords of dry wood and for over two thousand feet of logs. The wood cut was mostly dry. Any that was cut from trees burned last spring was charged twenty-five cents per cord.

Your obedient servant,

C. A. WALKINSHAW,

*Forest Ranger.*

## APPENDIX No. 5.

### REPORT OF JOHN RUTHERFORD, FOREST RANGER.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS AND CROWN TIMBER OFFICE.

CARLYLE, SASKATCHEWAN, April 7 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I beg to submit my annual report regarding conditions in the Moose Mountain timber reserve. As a result of the favourable season there has been a splendid growth of young timber, and the damage done by fire has been practically nothing, as there was but one small fire in the scrub, which was promptly extinguished.

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The supply of dry and fallen timber is now almost exhausted. The number of permits issued was hardly as large as in previous years, owing to the greater amount of coal now being used. The opening up of the trail from Fish lake to the old government road is a great convenience to the public as well as the ranger patrolling, and I would strongly recommend the widening of the trail through the Indian reserve from the Indian agency to the government road at Skeleton lake in view of the actual need of this trail as a road to Fish lake and a good fire-guard.

In conclusion I wish to say that the open season for deer should be closed for a number of years, as they are falling off in number to an alarming extent, owing to so many hunters hunting in the open season.

Your obedient servant,

JOHN RUTHERFORD,  
*Forest Ranger.*

## APPENDIX No. 6.

## REPORT OF JOSEPH COXE, FOREST RANGER.

DOUGLAS, April 6, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I beg to herewith submit my annual report in regard to the conditions in the Spruce Woods Timber reserve.

In the first place, I would like to say that the general conditions have been very favourable during the past year, owing to the fact that there has been very little damage done by fire. We have had a few small fires, but they did very little damage, if any, owing to the fact that there was very little timber in the places where the fire ran.

We planted 10,000 Scotch pine along with the others we had already planted, which were making a good growth. We also pulled and shipped about 30,000 small tamarack trees to Indian Head station for the nursery there. We also planted a large number of seeds of various kinds in the spring, as well as sowing a quantity last fall. We also picked 40 bushels of spruce cones, and pulled and shipped a car of moss for the nursery at Indian Head. We prepared and planted an experimental bed with seeds late in the fall.

Your obedient servant,

JOSEPH COXE,  
*Forest Ranger.*

## APPENDIX No. 7.

## REPORT OF NORMAN M. ROSS.

DEPARTMENT OF THE INTERIOR, FORESTRY BRANCH,  
NURSERY STATION,

INDIAN HEAD, SASKATCHEWAN, March 27, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I have the honour to submit herewith my ninth annual report, dating from April 1, 1908.

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Though the past season has been generally favourable to tree growth, unfortunately the winter of 1907-8 was the most trying since the commencement of the work, on all classes of young trees, shrubs and perennial stock. The fall of 1907, being wet and cold, was unfavourable to the early maturing of the new growth, while the winter was comparatively mild but very free from snow. The ground was very bare and exposed to strong drying winds, causing considerable damage even to a great deal of stock usually considered quite hardy. In our plantations the cottonwood suffered to the greatest extent, a considerable proportion of the new growth being killed back and in some cases the tree killed outright. In certain districts the ash and maple also suffered, though not to the same degree.

This trouble was general over the greater part of the three provinces, with the exception of southeastern Manitoba. In central Alberta the plantation suffered most. Following along the foot hills from about Olds to Cardston on the Macleod-Edmonton line there is a strip of country extending some miles east of the railroad with a comparatively high elevation, within which area experience seems to indicate that conditions for tree growth are more unfavourable than in other parts of the prairies. It will be necessary here to select most carefully the varieties for planting. In this district the Manitoba maple as a general thing has not given satisfaction, while the cottonwood frequently kills back in the most discouraging manner. The varieties which appear at present most suitable are the hardy willows and Russian poplars. The caragana seems to be hardy and could be introduced into the plantations to good advantage as a filler and nurse.

Though discouraging in many respects, such winter killing must be expected periodically, whenever the weather conditions are unfavourable to an early maturing of the new growth.

Growth during the past summer was very good. In most cases where winter killing was experienced the damage was entirely overcome by the more luxuriant growth of this season. The weather conditions in the fall of 1908 were very favourable to the early ripening of the young wood, so that we do not anticipate a repetition of the winter killing this year.

#### INSPECTION WORK.

In connection with the co-operative tree planting system the following were employed on inspection work :—

|                  |                      |
|------------------|----------------------|
| A. Mitchell,     | W. Guiton,           |
| A. P. Stevenson, | Jas. Kay,            |
| J. Caldwell,     | Jas. N. B. McDonald, |
| A. McIntosh,     |                      |

A brief report from each of these inspectors is appended, giving more detailed information as to districts covered and local conditions affecting the plantations.

As a whole the reports are most satisfactory, both regarding the success of the plantations and the greatly increased interest and general activity in tree planting all over the prairies.

Owing to the development of the work it was found necessary to appoint Mr. Arch. Mitchell as my assistant. Mr. Mitchell was, during the first few years of the operation of our tree planting system, engaged during the summer months as an inspector. He is particularly qualified for the position he now occupies, owing to his training in forestry work in Scotland and England, together with several years' experience of prairie conditions, particularly in Alberta, where since 1899 he has been actively engaged in agricultural work, devoting a large portion of his time to the subject of tree culture.

Two new inspectors, Jas. Kay and Jas. N. B. McDonald, were appointed this summer. Both have had several years' training in forestry on Scotch estates, and

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after considerable practical experience on the nursery station here, were considered competent to undertake inspection duties.

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## OFFICE WORK.

A great change was effected this season by transferring all office work in connection with the Tree Planting Division from Ottawa to Indian Head, thus centralizing the work and thereby making it more effective. This change seemed necessary for many reasons: First, large numbers of inquiries were being received at Ottawa requiring knowledge of local conditions before intelligent advice could be offered; second, considerable delays were frequently and unavoidably encountered in correspondence with applicants regarding the tree planting work, which, especially in the spring, often resulted in the necessary postponement of planting operations for another year; third, the correspondence at the nursery station was increasing so rapidly that it would, in any event, have been necessary to provide some suitable office accommodation; fourth, the inspector's reports and sketch plans were not always so satisfactory when worked up in the office at Ottawa as they should have been. By employing in the office only men who are thoroughly conversant with our inspection work and with local prairie conditions it is hoped to greatly increase the efficiency of this work.

The office was opened in rented quarters in town during the early part of November, 1908. Though it was some time later before the necessary stationery supplies, &c., were received, the work accomplished in this office is very considerable.

The office staff at present consists of Mr. Mitchell and tree planting inspectors Guiton, Kay and McDonald. The indexing and filing is under the charge of Miss Lauder. The inspectors prepare plans for the guidance of those applicants who are to receive trees, make up the distribution lists, and later on the lists of those to be inspected during this season.

Since its opening on November 1, 1908, we have received at this office 7,723 pieces of mail matter, principally inquiries regarding our tree planting work and applications for planting material and information.

During the same time 8,431 letters have been mailed; many of these are of course circular forms, &c.

Since opening we have started 3,640 new files. With the system of book and card indexing this entails a very considerable amount of work. Owing to the great development in railroad extension and in the general settlement of the country we find it very difficult to keep the indexes up to date, as new post offices and new express offices are being opened every day. We frequently find on file three or four letters from the same correspondent, each one giving a different post office address.

When properly equipped there is no doubt that our tree planting work can be much more effectively handled from this office than was possible when all correspondence was carried on from Ottawa.

To date we have 2,235 new applicants.

In the spring of 1908 trees were furnished to 1,424 applicants: 464 in Manitoba, 659 in Saskatchewan and 301 in Alberta; the number of trees distributed being practically 1,800,000. During the winter 1,002 planting plants were prepared and sent out.

We have on the distribution list being compiled at present the names of 2,010 applicants to receive trees this spring. According to provinces there are 559 in Manitoba, 1,095 in Saskatchewan and 356 in Alberta. To furnish these applicants we have heeled in at the nursery some 2,570,000 seedlings.

The following summary will give the best idea as to the popularity of the work among the settlers: Number of applicants on inspection lists, summer of 1908, 3,734; number of applicants who received trees spring of 1908, 1,424; number of applicants to receive trees in spring of 1909, 2,010; number of new applications received to date

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for trees to plant in 1910, 2,235 ; number of applicants to be visited in 1909, about 4,900.

As the inspectors' lists for 1909 cannot be accurately compiled for several weeks yet the last figure, though not definite, is approximately correct.

#### SCOTCH PINE PLANTING ON SPRUCE WOODS RESERVE.

The experimental plantings on the reserve were not extended this spring (1908) ; 11,000 two-year Scotch pine seedlings were planted in blanks of last year's plantation as owing to unfavourable season of 1908 a considerable number of the young plants failed to become established.

These experimental plantings were started in 1904 and have annually been added to, till at the present time the area set out aggregates about 25 acres. The planting has been limited to Scotch pine. The stock used has all been grown at the Nursery Station at Indian Head. In the first two years trials were made with seed of the native jack and lodge pine and the Scotch pine, and with one and two-year seedlings of Scotch pine. The results from the two-year seedlings are the only ones at all satisfactory. The one-year stock nearly all died. The seed in most cases germinated, but at present date the seedlings from seed sown in 1904 are barely an inch high, while the two-year old stock planted in 1905 are from a foot to over two feet. The seed was sown in 1904 in spots, prepared by spade about a foot square. In 1905 the seed was sown in the bottom of a shallow furrow and lightly raked in. It is possible that the reforestation by seed may be successful in certain sections of this reserve, namely, in the more hilly parts where there is some shelter afforded by poplar and willow shrubs; but on the level open portions conditions appear most unfavourable. Here it is almost certain that planting must be resorted to if successful results are desired. The system of planting as practised during the past three seasons, which I have described in previous reports, has given most encouraging results. Using two-year stock the cost per acre is comparatively small. Two year seedlings can be grown at considerably less than \$1 per 1,000 dug ready for planting. The actual planting under the system referred to, and under wages paid in 1906, was approximately \$5 per acre. It is doubtful if seed could be efficiently sown at a very much less cost than this.

As stated in my last report, Scotch pine was used, not because it was considered the best variety for the situation, but for the reason that the seed was readily obtained and stock easily propagated, the object of the plantings being chiefly to ascertain the probable cost of planting and the results likely to be attained from a very rough method of planting with the use of seedling stock. The success with the two-year stock would seem to indicate the inadvisability of using comparatively expensive transplants as this would greatly increase the initial cost of planting.

#### EXHIBITS.

The usual exhibit was again prepared for the summer fair at Brandon.

This season, at the request of the fair board, it is proposed to prepare an exhibit at the Calgary show.

In connection with these two exhibits, which will consist mainly of enlarged photographs of prairie plantations, it is the intention to set out in a suitable portion of the grounds demonstration plantations, showing varieties hardy in the locality and suitable for prairie windbreaks and plantations. The exhibition boards at both Brandon and Calgary are most anxious that such plantings be done. It is doubtful if any trees can be set out till 1910, however, as this season will be needed to get the ground in a suitable condition for the planting.

This kind of exhibit will undoubtedly prove much more valuable from an educational standpoint than the class of exhibit as prepared heretofore, and will naturally



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increase in value and instructiveness year by year. In connection with this planting it is proposed also to lay out a small nursery such as any farmer might have in connection with his home garden in order to raise his own planting stock on the farm.

## LECTURES, &amp;C.

The results of the work of this division have been generally disseminated, together with information relative to the establishing of prairie plantations, by the following means :—

*Farmers' Institutes.*—During the whole month of February Mr. Mitchell attended farmers' meetings in Alberta. Mr. A. P. Stevenson, during the same time, lectured in Saskatchewan and I personally attended institute meetings for one week.

*Special Lectures.*—Mr. Mitchell gave two special lectures in Calgary before the local horticultural society and the students of the normal school, while I addressed a farmers' convention at Regina on January 20 and also delivered two addresses before the Western Horticultural Society Convention in Winnipeg, February 18 and 19. These special lectures were illustrated by lantern slides.

*Bulletins and Pamphlets.*—Large numbers of Bulletin No. 1 on 'Prairie Tree Planting' have been sent out, two editions having been exhausted. A special pamphlet was prepared last winter, which was published in the spring, giving a résumé of the work of this division since the commencement of the work in 1901. In addition several thousand circulars and leaflets have been sent out.

*Press Articles.*—From time to time articles have been prepared for publication in the western agricultural periodicals, usually supplemented by photographs.

## NURSERY WORK.

The following areas were occupied during the growing season of 1908 with the various classes of stock :—

*Broad Leaf.*

- 19 acres, 1 year old Manitoba maple.
- 11 acres, 2 year old green ash.
- 16 acres, 1 year old green ash.
- 1½ acres, 1 year old American elm.
- 3 acres planted to willow cuttings for propagating stock.
- 1 acre planted to Russian poplar cuttings for propagating stock.

*Conifers.*

- 1 acre, transplanted native tamarack.
- 2 acres, transplanted evergreen conifers.
- ½ acre conifer seed beds.

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55 acres, total under nursery crops.

The season was only a fair one for nursery crops. The seed germinated well and made good progress till July, when we suffered from an extremely dry hot spell; this considerably shortened the growth, the effect being more especially noticed on the ash. The two year ash are somewhat undersized. During the winter they were entirely bare of snow covering and were consequently affected by this, while the summer was not favourable to a very luxuriant growth. The plants, however, are splendidly rooted.

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We have at present beeled in for distribution this spring the following:—

|                         |           |
|-------------------------|-----------|
| Manitoba maple. . . . . | 1,575,375 |
| Native ash. . . . .     | 743,000   |
| Cottonwoods. . . . .    | 256,000   |
| Total. . . . .          | 2,574,375 |

This number will be added to by making thousands of cuttings of the willows and Russian poplars.

Last spring over 100,000 willow cuttings were made for distribution.

As usual a portion of our maple seed was sown in the fall of 1907 and the remainder in spring of 1908. The seedlings from the fall sowing are considerably larger than those from the spring sown seed. There is always a possibility with this variety, owing to the rapid germination, for seedlings from fall sown seed to be cut down in an unfavourable spring. For this reason a considerable portion of this variety is always sown in the spring, and as a general rule we recommend that this variety be sown not earlier than the first week in May.

*Elm.*—This (1908) was an off seed year. With considerable difficulty we secured enough seed to sow  $1\frac{1}{2}$  acres. This seed is collected early in June and sown about the third week in that month. As a rule the seedlings make from 4 to 8 inches growth the first season and are left in the nursery for the following season, when they make good plants of from 18 inches to 2 feet in height.

*Birch.*—We have grown small quantities of this variety (native white birch) almost every year, but owing to the difficulty of obtaining seed and the comparatively great area required in propagating it has not been considered advisable to sow it at all extensively. The seed is very small and light and therefore cannot be covered deeply. We find it necessary to sow in screened beds where the seed germinates readily. When two years old the seedlings should be transplanted to nursery rows for one season in order to develop good roots for the final planting.

*Ontario soft maple (Accr Dasycarpum).*—Although this variety is not usually considered hardy in the west we have been able to secure seed from trees growing in Manitoba, near Morden, on the farm of Mr. A. P. Stevenson. We have several trees on the nursery grown from this seed which are now from six to eight feet high and have shown no sign of freezing back. In 1907 I secured some seed from Mr. Stevenson's trees and have raised some 5,000 seedlings, which came through the winter of 1907 without protection and matured up very well last fall. It is proposed to set out a test plantation with these seedlings as it is quite probable that the strain may prove hardy, at least in the more favourable districts. In this connection I might mention that seed of this same variety was secured from Pennsylvania in 1906, but each year the stock has been frozen back to the ground. The roots, however, have not been killed and last summer vigorous shoots from three to five feet long were sent up. These shoots do not appear to be so badly frozen this year.

*Willow.*—Three acres were this year planted to cuttings of the voronesh or Russian willow, in order to secure stock for distribution. The willow I consider as one of the most suitable varieties for the prairie, especially for formation of shelter belts. It is a rapid grower and will undoubtedly furnish fair fuel in a comparatively short time. One of the chief features in its favour is its ease of propagation by cuttings; so that any farmer owning a few plants can extend his planting almost indefinitely with no expense for nursery stock.

*Russian poplar.*—An acre was set out in cuttings of this variety, also for the production of propagating stock.

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Though generally we have not recommended the planting of the Russian poplar it has been found of value in certain districts and under certain soil conditions. Especially in parts of southern Alberta it will prove extremely useful, where the Manitoba maple and the cottonwood do not appear altogether satisfactory.

*Cottonwood*.—This variety is not grown on the nursery, stock being very cheaply secured from the natural growth along the sand bars in the rivers of North Dakota.

*Caragana (Arborescens)*.—Although this cannot be classed as anything but a shrub it will undoubtedly prove very useful for mixture in planting for South Alberta. For a fast growing hedge and garden shelter it can scarcely be excelled on the prairies. It will attain a height of nearly 12 feet in about 7 years but will not exceed this much in later seasons. Growing bushy as it does from the ground it furnishes excellent shelter and is perfectly hardy anywhere on the prairies. Three acres were sown to caragana in the fall of 1908. The stock, however, will not be ready for distribution till the spring of 1911.

In the fall of 1908, 14 acres were sown to green ash and 6 acres to Manitoba maple. More maple will be sown this spring, but not so large an area as usual owing to a scarcity of seed.

## COLLECTION OF SEED.

*Maple and Ash*.—Owing to an early spring and late spring frosts this was not a seed year for either of these varieties. As we already had on hand a large stock of ash seed we did not run short of this variety. But our supply of maple was very limited. It was impossible to secure seed in any quantity anywhere in Manitoba or Saskatchewan. We were able to get about 300 pounds of last year's crop from Brandon, which, added to a small quantity of our own, will give us enough for about ten acres. This is a considerably less area than we should have, but in future we shall be in a position to make up any deficiency in seedling stock with cuttings of willow and Russian poplar.

*Elm*.—It was an unfavourable seed year for this variety also though we were able to collect enough seed to plant 1½ acres.

*White spruce*.—About 35 bushels of cones were collected by the ranger on the Spruce Woods reserve and forwarded here. Something over 30 pounds of seed were extracted.

*Jackpine*.—About 45 bushels of cones were collected in the Prince Albert region and sent to the nursery for seed. As some of the cones were extremely old the seed did not turn out well. The old cones do not open as readily as the fresher ones and the seed in many cases appears to have decayed. About 22 pounds was extracted.

*Lodgepole pine (P. Murryana)*.—About 40 bushels of this variety was also collected in the Cypress hills south of Maple creek. The cones of this pine seem to be the most difficult of all varieties to open, the older cones especially often remaining closed after being submitted to intense heat. If no cones older than two years could be collected there would not be much difficulty in extracting the seed and getting a fair yield to a bushel of cones, but owing to the habit of the jackpines retaining cones for several years it would be almost impossible to prevent collectors picking by the bushel from gathering a large proportion of old cones. About 29 pounds was extracted.

*Pinus Ponderosa*.—A small supply was obtained from seed picked in the higher altitudes of the Black hills of North Dakota. It is thought that this may prove a suitable variety for prairie planting.

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*Abies Concolor*.—A small lot of this seed was also obtained for testing on the nursery.

## CONIFERS.

We are gradually working up a stock of evergreen conifers which should be ready for distribution in 1911. The varieties which will be most extensively propagated are native white spruce, native jack and lodgepole pine and Scotch pine. Very little, comparatively, is known as to the suitability of various evergreens for prairie planting, especially under plantation conditions. Evergreens have been planted in most of the settled districts, but usually with only moderate success. The average man gets a spruce or pine, and as it is somewhat of a rarity, he plants it out in the centre of his lawn or in some other equally conspicuous and exposed position. Consequently, as a rule, the poor evergreen has to withstand the most adverse conditions of exposure to wind and sun. The failures resulting from this kind of planting do not indicate that these varieties are not hardy. If only moderate care is taken to have conditions resembling, at least as far as possible, those under which the tree thrives in its natural state, much greater success may be hoped for.

Where evergreens are planted they should be set out close together in large numbers for mutual protection, or should be protected in some manner by broad leaf varieties, shrubs or sunflowers; anything, in fact, that will hold snow in winter and keep the young plants well covered, especially during the first winter.

Though as above stated it is proposed to propagate for distribution only a few of the very hardiest varieties, there are many other conifers likely to prove suitable for prairie planting.

The following is a list of conifers at present on the nursery with the ages of the stocks :—

*White Spruce.*

- White spruce, 1, 2 and 3 year seedlings up to 8 years old transplanted.
- Colorado spruce, 2 year seedlings up to 10 years old transplanted.
- Sitka spruce, 2 year seedlings.
- Picea ajanensis*, 1 year seedlings.
- Norway spruce, 4 years transplanted.
- Norway spruce (*Septentrionalis*), 1 and 2 year seedlings, 4 years transplanted.
- Scotch pine, 1, 2 and 3 year seedlings up to 6 years transplanted.
- Jackpine, 1, 2 and 3 year seedlings to 4 years transplanted.
- Lodgepole pine, 1, 2 and 3 year seedlings to 4 years transplanted.
- Cembra pine, 3 years transplanted to 6 years transplanted.
- Flexilis* pine, 3 year transplanted.
- Ponderosa pine, 1 year seedlings, 3 years transplanted.
- Norway pine, 3 year seedlings.
- Dwarf mountain pine up to 6 years transplanted.
- Douglas fir to 5 years transplanted.
- Balsam fir to 5 years transplanted.
- Nordman's fir, 1 year seedlings.
- Concolor fir, 3 year transplanted.
- Dwarf juniper up to 6 years transplanted.
- Common red cedar up to 6 years transplanted.
- European larch, 7 years transplanted (9 feet high).
- Siberian larch, 1 year seedlings to 4 years transplanted.
- Native larch or tamarack, 1 year seedlings to trees 10 feet high.
- Larix leptolepis*, 2 year seedlings.

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Trials are also being made with a small collection of conifers, the seed of which was obtained in Japan, also with seed procured from Northern Russia and Finland.

At present date there are over 10,000 square feet of shaded seed beds on the nursery containing fall sown seed and 1, 2 and 3 year seedlings, 1 acre of transplants of Scotch pine and spruce set in 1908, and 1 acre of swamp pulled tamarack set in the same year.

Considering the somewhat unfavourable conditions for evergreen propagation which at present prevail on the nursery, owing to exposure, newness of soil, &c., the results obtained are very encouraging, and indicate that with adequate shelter the propagation of such varieties as spruce and pine may be very successfully carried on in this country.

*The Native larch or tamarack* has again made especially good growth in the plantations. It seems to be a very easy variety to transplant, is very hardy, and a rapid grower.

The *European larch* appears hardy and makes very strong growth, but owing to the very early date at which it buds out in the spring the time for transplanting is short. Transplanting does not seem successful after the buds have opened.

*Siberian larch.*—This variety matures up earlier in the fall than the European, losing its leaves eight to ten days sooner. The native larch is bare of leaves several days earlier than the Siberian. In this climate varieties maturing early in the season are the most desirable. It is probable then that the Siberian form of the larch will prove more suitable for our conditions than the common European.

PERMANENT PLANTATIONS.

We have now about 40 acres under permanent plantations, 25 acres being set out last spring (1908). These permanent or test plantations will be added to each season as new land can be prepared for planting, the object being to ascertain the best varieties and best mixtures for prairie planting for the production of fuel, fencing and other material.

The following is a list of permanent planting to date :—

*Permanent Plantations.*

In 1904—

|  | Feet. |
|--|-------|
| Main belt of Manitoba maple, cotton wood and willow, . . . | 3 x 3 |
| Plantation No 1, tamarack and white spruce, . . . . .      | 3 x 3 |

In 1905—

|   |       |
|---|-------|
| No. III—Tamarack, Scotch pine and White spruce, . . . . .                           | 3 x 4 |
| No. XI—European larch, . . . . .  | 3 x 3 |
| No. XII—Maple, cottonwood, elm, European larch, tamarack, white birch, . . . . .    | 4 x 4 |
| No. XIII—Scotch pine and white spruce under large maples and cottonwoods, . . . . . | 4 x 4 |

In 1906—

|  |       |
|--|-------|
| No. II—Scotch pine and white spruce, alternate rows, . . . | 3 x 4 |
| No. IV—Scotch pine (French stock), . . . . .               | 3 x 4 |
| No. V.—Scotch pine (stock grown at Indian Head), . . .     | 3 x 4 |
| No. VI—Cottonwood, . . . . .                               | 3 x 4 |
| No. VII—Cottonwood and Manitoba maple, alternate rows      | 3 x 4 |
| No. VIII—Manitoba maple and white birch, alternate rows,   | 3 x 4 |
| No. IX.—American elm and green ash, alternate rows, .      | 3 x 3 |
| No. X—Russian poplar, . . . . .                            | 4 x 4 |

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In 1908—

|  |    |   |    |
|--|----|---|----|
| No. XIV—White willow.....  | 3  | x | 3  |
| No. XV—Golden willow.....  | 3  | x | 3  |
| No. XVI—Acute leaf willow.....                                   | 3  | x | 3  |
| No. VII—European larch and green ash, alternate rows..           | 3½ | x | 4  |
| No. XVIII—Tamarack and green ash, alternate rows..               | 3½ | x | 4  |
| No. XIX—Tamarack.....  | 3½ | x | 4  |
| No. XXIII—Tamarack and Manitoba maple, alternate rows            | 3½ | x | 4  |
| No. XXII—Scotch pine and green ash.....                          | 3½ | x | 3½ |
| No. XX—Lodgepole pine.....                                       | 3½ | x | 3½ |
| No. XI—Lodgepole pine and green ash, alternate rows..            | 3½ | x | 3½ |
| No. XXIV—American elm.....                                       | 3½ | x | 4  |
| No. XXV—Cottonwood.....  | 3  | x | 3  |
| No. XXVI—Cottonwood, birch, tamarack, ash, maple and willow..... | 4  | x | 4  |

These plantations vary in size from ½ acre to 3 acres.

Last spring, as above stated, 25 acres were planted; about 5 acres were put in with spades, 14 acres planted directly in plough furrows, and 6 acres with iron dibbles. In all cases the ground was first marked out with cross drills to ensure the rows being straight and even both ways for horse cultivation.

|  | Per acre. |
|--|-----------|
| Planting with spades the cost averaged.....  | \$ 9 99   |
| Planting with dibbles the cost averaged..... | 6 52      |
| Planting with plough the cost averaged.....  | 6 33      |

Dibbles can only be used successfully for cuttings, as a rule, one and two year seedlings have too well developed a root system.

In planting in plough furrows we use a two-horse walking plough. The rows are five chains long. In order to keep the plough team busy a gang of five men and a boy, besides teamster are necessary. The boy sets the stakes for the plough furrows and the five men plant certain sections of the rows as soon as the plough passes. The furrow is opened up as deeply as possible running the plough twice in each furrow, throwing soil both ways. The planters only set the tree and tramp in enough soil to hold it firmly, the filling in is done by another man with a single horse cultivator.

When spade planting, the planters work in pairs, one man making the hole, the other carrying the seedlings, setting them and firmly tramping the soil. This is the method we use in planting the evergreens, as the stock being small would not be evenly covered if planted in furrows.

Plantations of maple, cottonwood, and others of the fast growing varieties, require cultivation and hoeing for at least three seasons. We find that the average annual cost per acre for hoeing is from \$4.70 on new clean land to \$9 on older land.

Horse cultivation averages \$1.12 an acre.

These prices are arrived at from the time spent on the work and the actual wages paid on the nursery. On the average farm a few acres of trees could easily be cared for without in any way materially increasing the usual expenses, as the actual time employed is very little and special help would not be hired for this purpose.

The following table showing the percentage by actual count of dead trees in the 1908 plantations may be of interest. The count was made in September.

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*Permanent Plantations—1908 Planting.*

| Variety                 | No. of trees planted. | Per cent died. |
|-------------------------|-----------------------|----------------|
| Willows (cuttings)..... | 9,832                 | 46.4           |
| European larch.....     | 2,406                 | 22.02          |
| Tamarack.....           | 12,015                | 2.1            |
| Ash.....                | 13,308                | 5.4            |
| Lodgepole pine.....     | 5,745                 | 9.8            |
| Scotch pine.....        | 3,244                 | 4.3            |
| Manitoba maple.....     | 3,003                 | 3.7            |
| Elm.....                | 5,351                 | 1.6            |
| Cottonwood.....         | 6,906                 | 17.6           |

The soil was fresh backsetting, ploughed a third time. The willow cuttings were damaged a great deal by gophers, which cut off the young shoots as soon as they appeared above the ground. The cuttings were also set early in spring, while the ground was still very cold, some three weeks before the general planting was commenced. Had the cuttings been set later in the season it is not likely that there would have been the same percentage of failures.

It is interesting to note the difference in the death rate between the European larch and native tamarack, the latter being only 2.1 per cent.

An additional 12 acres has been prepared for planting this spring (1909).

*Exhibition Plots.*

Last spring several small exhibition plots were set out; these contain 100 trees each, set 4 x 4 feet. The plots are arranged side by side in order that one variety may be easily compared with another. These plots will be added to each year till a complete collection of all hardy varieties is obtained. The following plots were planted:—

|                      |   |
|----------------------|---|
| Scotch pine.         | Siberian larch.                         |
| Cembra pine.         | Colorado spruce.                        |
| Dwarf mountain pine. | Native white spruce.                    |
| Lodgepole pine.      | Canada spruce (from Black hills, N.D.). |
| Jackpine.            | Balsam fir.                             |
| Tamarack.            | Cedar.                                  |
| European larch.      | White birch.                            |

*Ornamental Grounds and Shrubbery.*

The shrub borders have made splendid growth and now add greatly to the attractiveness of the nursery. Many of the varieties are now coming into bloom. The following are the varieties used most extensively, all of which have proved absolutely hardy during the past four seasons:—

|                                       |                            |
|---------------------------------------|----------------------------|
| Caragana arboreseens.                 | Spirea Van Houtii.         |
| Caragana pygmaea.                     | Spirea Billardii.          |
| Flowering currant.                    | Spirea arguta.             |
| Red twigged dogwood.                  | Spirea opulifolia.         |
| Tartarian honeysuckle.                | Japanese rugosa roses.     |
| Albert Regel's honeysuckle.           | Dwarf or trailing juniper. |
| Lilacs, common, Persian and Joseka's. | Dwarf mountain pine.       |
| Ginnalian maple.                      |                            |

The Japanese rugosa rose is particularly worthy of notice. It is very hardy, has a most beautiful foliage, blooms profusely over a very long period, and after blooming produces immense hips of a bright scarlet colour which remain on the bushes well on in the winter.

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All our shrubs are planted thickly and are so arranged as to be well covered with snow during winter. At present date, though the adjoining fields are perfectly bare, all the shrub borders are drifted from two to five feet deep. This winter covering is most beneficial to all flowering shrubs and herbaceous perennials.

During the summer the perennial plants gave an especially fine show of bloom, though the latter part of the season was too hot and dry for good success with annuals.

Perennials that may be particularly recommended as being specially hardy are the German iris, perennial larkspur, Iceland poppy, columbines and peonies.

This season a small lawn and some additional shrubbery planting were laid out around the new boarding house.

#### *Ploughing and Farm Work.*

Sixty acres of fresh ground was broken up and backset. About 12 acres of this was reploughed very deeply to put it in condition for permanent planting. About 20 acres was summer-fallowed for nursery work and 30 acres ploughed in fall after trees had been dug and put in shape for spring sowing. A supply of feed oats and hay was also harvested.

#### *Buildings and Permanent Improvements.*

A small building for the extraction of coniferous seeds was erected in the fall at a cost of about \$500. One end of this building, 20 x 16, is equipped with a hot water heater and fitted up with suitable drawers or trays for drying and opening the cones. The other end, 16 x 18, is for the extraction and cleaning of the seed. During the early part of the winter about 120 bushels of spruce and pine cones was opened here.

Connection with the town waterworks was completed in September. The main pipe leading into town cuts across a portion of the nursery. This was tapped at a convenient point, giving a plentiful supply of splendid water under a very good pressure. This will be particularly beneficial for the growing of young coniferous stock. There is no doubt that with artificial watering the young plants can be brought to a suitable size for permanent planting at least a year sooner than if grown without any such watering.

In conclusion I would say that the results, both at the nursery and at the outside plantations, are most gratifying. The co-operative planting system is becoming well known and extremely popular through the prairie country. It is conceded on every hand that the work will prove of immense value to the country and should be developed to even greater proportions.

Your obedient servant,

NORMAN M. ROSS.

### APPENDIX No. 8.

#### REPORT OF ARCHIBALD MITCHELL.

DEPARTMENT OF THE INTERIOR,

FORESTRY BRANCH,

NURSERY STATION,

INDIAN HEAD, SASKATCHEWAN, February 18, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I have the honour to submit herewith the following brief report of my work as assistant in the Tree-Planting Division of the Forestry Branch.



## SESSIONAL PAPER No. 25

I joined the Forestry Branch on March 1, 1908, and on that date left Edmonton to go to Indian Head to take up my duties there.

A short time before I had been requested by Mr. Bryan, the Principal of the Provincial Normal School at Calgary, to give the students there an address on tree planting, and on my way through Calgary I stopped off and did so. After the meeting was over Mr. Bryan asked me to give his students a similar lecture, any time I happened to be in Calgary during each session of the school, and, I understand, supplemented and confirmed this request by correspondence with yourself.

The idea of giving the young teachers of Alberta some idea of prairie planting and the general principles of forestry is, I understand, the outcome of a requirement in their curriculum, and which I think reflects great credit on the Educational Department of Alberta. They thus recognize the importance of some knowledge of forestry throughout the West, and are taking what steps they can, through the public schools, to bring that knowledge to those whom it will most benefit. I regret to say that I was not able to be in Calgary during the last session of the Normal School, as my inspection work kept me in Saskatchewan during the summer and fall, but I hope in the future to be able to comply with Mr. Bryan's request as far as possible.

After assisting, at Indian Head, with the packing of the trees for distribution and the other work going forward in the nursery, on May 12 I went down to the Spruce Woods reserve east of Brandon and collected seedling tamarack from the swamps there and forwarded them to the nursery at Indian Head. While in the reserve I also planted 10,000 young Scotch pine seedlings in the fall places of the forestry experimental plots which have been planted there in recent years. These plots have been quite successful and the plants are beginning to show well above the grass in the older plots.

The collection of elm seed was my next work, and this was done in the Qu'Appelle valley about 24 miles north of Indian Head. Seed was very scarce and several heavy gales and thunder showers at picking time made it still less, so that only a small quantity was obtainable.

After the seed gathering I went west to Alberta with Mr. J. N. B. McDonald, one of the new plantation inspectors, to go over a portion of his territory with him and give him some idea of his work. Alberta is my old inspection district and I was able to point out to him the different local conditions prevailing in that province, all of which have to be considered in the successful growing of trees in that part of the country. This took about two weeks, and on my return to Indian Head I immediately went to Manitoba and spent a few days with Mr. A. P. Stevenson and another new inspector, Mr. Jas. Kay, looking over some of the oldest plantations in Manitoba, and getting some idea of planting conditions in that province generally.

The forestry exhibit at Brandon Summer Fair next took up my attention. This Mr. Ross and I thoroughly overhauled, and it was a source of much interest to the visitors at the fair, hundreds of whom visited it. I was in attendance during the five days the exhibition lasted and was able to supply a good deal of information about planting on the prairies, arranging plantations, setting out gardens, and so on, in answer to inquiries.

On my return from Brandon, about July 20, I commenced inspecting plantations and continued until about October 24. The district assigned to me was the northern part of the prairie sections of Saskatchewan, chiefly along the Grand Trunk Pacific and Canadian Northern Railways to the boundaries of Manitoba and Alberta respectively.

The number of parties on my list to be visited was 406 and of these 301 were new applicants. Of the new applicants 150 were prepared to plant, while 151 had made no preparation. Many of the latter are new settlers and, while unable to undertake any

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preparations for planting in 1908, almost invariably requested that their names be carried over for next year's inspection.

Of the 50 per cent of new applicants who had land prepared for planting, only a little over 40. per cent had their proposed plantations arranged in an entirely satisfactory manner, that is, had their strip of prepared land wide enough and large enough for best results, and at a proper distance from their buildings. These are matters about which the farmers, as a rule, have very crude ideas, and there is no doubt that in this connection lies one of the most valuable features of the work of the inspector, for in these cases where the applicant has not made a good arrangement of his proposed plantation, or has not made a start at preparing the land, the inspector is able to go over the ground with him and point out the best arrangement his experience may suggest, and even, as is frequently done, leave a sketch plan for his guidance. It is also worthy of note in this connection that the men from Manitoba, or the older portions of the Western States, usually require little or no help in this direction. They have been through it all before and know the evil of having their buildings crowded closely round by various strips, and, as a result, you find them with wide belts, inclosing wide and long spaces within which there is plenty of room for new buildings, garden, orchard, calf or pig paddocks, and so on.

The trees planted in 1908 were as a rule well planted and cared for, and very few cases of slovenly work were met with. The necessity for thorough preparation and careful cultivation afterwards seems to be becoming quite widely recognized throughout the country, and quite an improvement in this respect is to be found compared with what it was in 1902 when I made my first inspection trip.

The older plantations are doing excellently well and I was able to take a number of photographs of some of them, so that some record of their progress might be available in the office.

It is indeed a pleasure to see some of these plantations now, five or six years old and 12 to 16 feet in height, inclosing the farmers' premises and affording shelter, no matter how the wind may blow. Such plantations are usually quite a landmark in the district and as a rule act as an encouragement and stimulus to other farmers to do likewise.

While in Alberta, in that part of it between about Nanton and Red Deer, I found many of the older plantations and especially the cottonwoods in them, badly damaged by the previous winter's frosts. This was not altogether unexpected, as in 1907 there was a severe freeze about the middle of August in these higher districts, which caught the trees while the leaves were still on and the plants in full vigour of growth. The leaves were badly blackened and consequently the trees were unable to ripen up before winter, with the result that most of them were badly damaged during the cold weather.

The cottonwoods have always been more or less susceptible to frost-hurt in these districts, and it will probably be better to send fewer of them for a few years and try Russian poplar and perhaps the acute-leaved willow instead. Russian poplar, as is well known, has certain disadvantages which do not make it advisable for planting in certain situations, but I think that this case is exceptional.

One of the reasons why the Russian poplar is not to be recommended for general planting is the fact that its roots spread wherever possible into cultivated land adjoining and there send up a multitude of suckers, which, in time, may become very objectionable. In the middle of a good wide belt, however, it should not give so much trouble in this respect.

Another objection to the Russian poplar has been found in its liability to sun-scald and disease, but it would appear that certain varieties of it are not so easily affected in this way as others. It seems that the varieties with spreading branches and thick leaves are more exempt from trouble of this sort than those with upright

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branches and thin leaves. The bark is thicker and the set of the branches is such that they seem to afford a better shade and protection from the sun's rays. In the Porcupine Hills, about 9 miles west of Staveley, at the Oxley ranch, there are other Russian poplars of this wide spreading variety which are about 35 feet high and about 16 years old, and which are quite sound and in good order. West of Saskatoon this summer I also saw a number of Russian poplar plantations seemingly of the same variety which were about 15 years old and about 32 feet high, from 4 to 5 inches in diameter 4 feet up, and remarkably free from disease. The parent tree was also quite sound and it is interesting to note that it was obtained as a cutting from Dr. Saunders, of the Central Experimental Farm, Ottawa, 17 years ago.

From these examples I should judge that the Russian poplar might, with advantage, be introduced into our plantations in the higher altitudes where the cottonwood is inclined to be tender. Some one of the fast growing poplars is desirable as a mixture in the plantations in order to obtain rapid height, growth and shelter, and even although the Russian poplar might not be a very long lived tree, if judiciously mixed, it could be cut out when its usefulness as a rapid shelter was past, without detriment to the plantation.

I may mention that Mr. Ross takes a similar view of this question and that arrangements are being made to send a number of Russian poplar cuttings into these higher districts in spring.

The acute-leaved willow is also proving pretty hardy in these districts, and at the Oxley ranch there is a specimen about 30 feet high and 16 years of age.

After returning to Indian Head from my inspection tour I was engaged for a short time in the nursery and latterly in the office revising the work of the summer and arranging in detail the quantities of trees to be shipped in spring and preparing plans and other office work. On February 1 I started for Alberta to carry out a month's series of institute meetings.

Perhaps it may not be out of place to mention that, after my being away from any connection with the Forestry Branch for two years, I find on my return to it all over the several districts I have been in this past summer, quite an improvement in the attitude with which the work of prairie planting is viewed by the farmers. Men look at it now with confidence instead of almost suspicion as they were often inclined to do at first, and the community is coming more and more to recognize the value of the assistance rendered them. The *need* of the trees never was questioned at any time, but there seemed in many cases to be a feeling as if they were afraid of compromising themselves in some way by signing the Tree Planting Agreement. Now, as a rule, the men seem to understand the conditions and frankly and with alacrity accept them, and it is seldom necessary, on the inspector's visit, to explain the agreement so fully in detail as it used to be. They know it already and recognize it as a protection for their plantations and necessary for their success in growing them.

To the men from Ontario and eastern Canada generally, who have been somewhat used to government assistance in agriculture, the tree planting movement, while highly appreciated, is not so striking a thing as it is to the settler from the old country and the continent of Europe. These, coming from the wooded countries, recognize at once the need for trees, and appreciate highly the efforts of the government of Canada in attempting to supply their need, the more so, as such assistance is unknown where they come from.

The new comer from the States has been used to assistance in various directions in his farming operations, and also, in some cases, in tree planting, but he also, nevertheless, seems to value very highly the opportunity he finds in this country for obtaining a quantity of planting material grown in the country, and adapted to its requirements, with instructions as to the disposal of it, free of charge.

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Altogether, it would appear to be becoming well recognized on all hands that the tree planting movement is a very worthy one, and one readily finds, in conversation with the farmer, that nearly every one of them intends to take advantage of it as soon as he finds himself firmly enough established, and able to undertake the work of planting.

I am, sir, your obedient servant,

ARCH. MITCHELL.

### APPENDIX No. 9.

#### REPORT OF A. P. STEVENSON.

DEPARTMENT OF THE INTERIOR,  
FORESTRY BRANCH,  
DUNSTAN, MANITOBA, NURSERY STATION, February 26, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR.—I have the honour to submit the following brief report on the work done by me as tree planting inspector in connection with the work carried on in this province (Manitoba) by the Forestry Branch of the Department of the Interior, during the summer of 1908.

I began inspection work on the 15th of June. It was soon noticed that the previous winter had done some damage to the young growth of the previous year. The evidence of this injury was not so great in the Red River valley, but in the western part of the province it was noticed and the previous year's growth had got considerably killed back. The cottonwood and Manitoba maple were the chief sufferers. The ash, elm and Russian willow came out all right.

I might note that the winter of 1907-8 was a very trying one on our own grounds, the injury from what is known as winter killing being the greatest in many years. This was especially noticeable among the young trees that had made strong, vigorous growth during the previous summer. I believe the trouble was caused by a very late spring followed by a summer of excessive growth. An early frost caught the young immature growth full of sap, with the above mentioned result. This is the only explanation I can give; it was not excessive cold, as the winter of 1907-8 was a comparatively mild one.

I do not anticipate any unfavourable results this spring, the young growth ripening up its wood well in the fall, the soil also being full of moisture at the close of the season, which is of great assistance to trees of all kinds wintering well in this country.

On June 30, Mr. Arch. Mitchell, assistant in Tree Planting Division, Indian Head, arrived in Morden to examine some of the plantations in that locality. He was accompanied by Mr. Kay, of the Forest Nursery Staff, who was later to take part in the inspection of tree plantations. Various plantations were examined in the Morden, Dunstan and Clegg districts. A day was also spent in the Baldur district. On leaving for Indian Head on July 3rd Mr. Mitchell expressed himself as being highly pleased with the growth and appearance the young plantations had made in so few years.

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Mr. Kay accompanied me on inspection work until July 11, when he left to take up inspection work on the main line of the Canadian Pacific Railway and its northern tributaries, including the Glenboro' branch from St. Claude to Sinclair. The district covered by myself was the Red River valley and westward to the western boundary of the province, taking in all the country south of the Glenboro' branch of the Canadian Pacific Railway and also the main line of the Canadian Northern Railway from Winnipeg northwest to Roblin.

The spring of 1908 was a very favourable one for the growth of all tree and plant material of any variety, the rainfall being well up to the average. The percentage of young trees growing that were set out in the spring of 1908 is fully 85 per cent. The older trees also, that had lost some of their last year's wood, quickly recovered from their slight setback, the vigorous growth made being good evidence that their vitality was not in any way weakened.

About the beginning of July the weather set in dry and very hot, the drought lasting till after harvest, but little or no damage was noticed among the young plantations, the trees having a good start and being well established before the dry weather set in. This, together with the thorough preparation of the land before planting, made all the difference between success and failure; for without doubt, had the land not been thoroughly prepared previous to planting, few trees would have survived through the dry heated term that was experienced in southern Manitoba.

It is with pleasure I again note the continued good behaviour of the ash tree and its growing popularity with the farmers.

The Russian willow is being much sought after. Inquiries for this hardy, quick-growing tree are very much on the increase, its general good behaviour under almost all conditions being the cause. One year old rooted cuttings only, if possible, should be sent out to planters.

A few of the first farmers to take advantage of the government co-operative scheme to secure a shelter belt are now turning their attention to the growing of a wood lot for the purpose of raising their own fuel. They find that the work of attending to a block of an acre or two of trees is not such a difficult undertaking as they anticipated when the land is clear of weeds to begin with, and as a horse and cultivator can be used both ways to advantage very little hoeing is required.

In June a visit was paid to the Forest Nursery Station at Indian Head. To the man in the street it is difficult to realize that only four years ago this place was a piece of bare, raw prairie. The transformation that trees, rightly placed, can give to a piece of bare prairie is here realized. It is a great object lesson, and the doubting Thomas goes home strengthened and encouraged to plant trees, convinced that no ideal home can be had without them.

The valuable tests being made with the various kinds of coniferous trees in order to find out their adaptability for prairie planting were also noted. This is a line of work of which practically nothing is known at the present time. The results of these tests will in a few years be of great value to the people of the west. The demand for information on this subject is yearly on the increase, and without doubt it is the desire and ambition of all tree planters to grow successfully a few evergreen trees.

Your obedient servant,

A. P. STEVENSON.

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## APPENDIX No. 10.

## REPORT OF ANGUS MACKINTOSH.

DEPARTMENT OF THE INTERIOR,  
FORESTRY BRANCH,  
HEADLANDS, NURSERY STATION, SASKATCHEWAN, December 11, 1908.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I beg to send you herewith a brief report upon the tree planting inspection work with which you entrusted me this year (1908).

I began work on the 15th June at Lipton, and from there zigzagged the country as far as Lanigan. Then turning back I worked from Lipton to Kirkella; and after from Lumsden to Saskatoon on the Prince Albert Railway.

I found the plantations that I inspected on the whole in a satisfactory state. There were of course a few exceptions, where the keeping down of weeds and cultivation had been neglected.

The plantations made three or four years ago are now showing up well, the trees in many places are from 10 to 13 feet in height and shading the ground thoroughly. These plantations need no further soil cultivation.

The plantations set out last spring, and the spring before that, are also doing well, and taking them all over the average failures do not exceed 7 per cent.

There is not so much cutting back among the cottonwoods noticeable this year as there was last year. Most of the trees injured last year have now recovered, and have this year made good growth. This year's shoots seem to have matured well, and look as if they would stand the winter unscathed. As I have remarked in previous reports, there is always more cutting back on soils that have been heavily manured than on unmanured ground. I always tell the tree planters not to manure, as the prairie soil is generally rich enough for forest trees without any artificial fattening.

You will notice on my books, some applicants who wish their applications cancelled, and others who did not have their ground properly prepared. That is mainly owing to the bad seasons we have been having lately, and the discouraging effects they have upon homesteaders who, to begin, had very little capital, and are now deeply in debt. Tree-planting is not of much interest to a person who can hardly secure the necessaries of life. This year on account of bad times I found more empty shacks in my travels than in previous seasons. Quite a number of applicants, mainly bachelors, were away from home trying to earn a little money. Their neighbours often do not know where they are, and thus long drives at times produce no effects.

I find there is a growing desire among those who have plantations three or four years of age for more ash than maple, and that their first impression regarding ash as a slow grower is getting gradually dispelled. They find that when the other trees close in upon the ash it shoots upward, gives a good account of itself, and keeps pace with its neighbours; also that it does not run so much into straggling branches as the maple, and promises to make more useful timber.

Quite a number of people who with care have made their shelter belts a success, ask from time to time if there is any likelihood of conifers being distributed in the near future.

I think it would be advisable to increase the number of trees granted to those who have shown, by the care they have taken of the first lot sent them, that they are worthy of more; to give them, if they have ground well prepared, from 2,000 to 2,700 as a second grant.

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I this year visited for the first time some places far back from railways, where trees were sent without the ground having been inspected, and I am glad to say that the statements made by the applicants, as to the state and situation of their ground, were in most cases correct, and that the trees have been well planted and well cared for. Those outlying places take up a good deal of the inspector's time, but they should be visited once in two years at least.

Your obedient servant,

ANGUS MACKINTOSH.

## APPENDIX No. 11.

## REPORT OF JOHN CALDWELL.

VIRDEN, MANITOBA, February 6, 1909.

R. H. CAMPBELL, Esq.,  
Superintendent of Forestry,  
Ottawa, Ont.

SIR,—I beg to submit to you herewith my report for the summer of 1908. I began work on June 15, and ended November 30. I had more names than usual on my list, and to finish properly I should have started on June 1.

My territory was the Canadian Pacific Railway main line from the Manitoba boundary west to Regina, from Regina back east to Manitoba on the Arcola line, the Reston and Wolseley line, and the Canadian Northern Railway from the Manitoba boundary to Regina.

During my first two or three years' work among the farmers I found considerable prejudice, partly political, and helped on by tree agents who would like the farmers to believe that signing the agreement presented was almost like placing a mortgage on the farm.

This feeling on the part of the farmers had almost entirely disappeared. They realize that the splendid work that is being done is just what is wanted in wide open prairie country where farmers are settling down by thousands, and to live in a home probably not within miles of a tree, is dreariness and desolation. In order to make a home anything near homelike, it is absolutely necessary to plant trees, and to plant a good many.

There are so many rich plantations springing up here and there all over my territory, that it has become a matter of course for the farmer to get his name on the list, and to take government trees as soon as he is ready.

Of course, we are working in a new country where most of the farmers are more or less hard up, and where so many improvements have to be made, and it is sometimes hard for them to do things just as well as they themselves would like, so it is up to the inspectors to impress upon them the importance of having their land well prepared, and to take no more than they can care for properly.

My instructions this season were to give no man more than 1,500 for the first time. I gave quite a few less than that; but once in a while I come across a man who, I feel sure, is quite capable of caring for at least 3,000, and who may be anxious to plant them all at once. In that case I book him for what I think he should have, and make a note to that effect on the margin. However, our motto should be, 'What we do, do it well.'

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We are bound to meet with a few failures or partial failures, and I believe as time goes on when one farmer has a splendid plantation and his neighbour's trees are only middling or worse, then is a good time to become even more strict, as they can see that the growing of a fine grove is entirely in their own hands, and is simply a question of good or bad management.

The stock sent out from the forest nursery at Indian Head is the very best for the purpose, and generally, reaches the farmers well packed and in good order. The cottonwood is the only variety which, I believe, has sometimes reached the farmer a little out of condition. There may be a little danger of them being dried or heated on the road up from Dakota, or being tied too tightly when being buried for the winter.

This last winter was a splendid try as to the hardiness of the different varieties. The previous summer being cold and wet, the growth had a very poor chance to mature, which left them in poor shape to stand the winter, and a light snowfall made it worse. The cottonwood suffered by far the worst, most of them being badly frozen back, and a few frozen dead.

The elm, ash, maple, willows and Russian poplar all stood the test well. I noticed a few maple, ash and elm killed, but in each case the cause was shallow planting, which is a fatal mistake. These young trees stand a poor chance of living with half an inch or more of the root above ground.

The cottonwood in Saskatchewan seems to do well, and those that were frozen back made great growth this last summer.

The willow cuttings which have been sent out have done well, and are a splendid mixture in a plantation. Few Russian poplar have been sent out lately, but Mr. Ross is getting quite a stock at the nursery, and I would say to send out some. I would not advise planting many on good land, but where the land is sandy or a gravelly bottom, then Russian poplar is one of the best.

The elm has done only middling. It seems to grow slowly, and is liable to be chewed off by rabbits, but when they once come up to six or eight feet they do better, and in the long run elm and ash should be the best. The ash has given pretty good satisfaction right from the start.

The native maple, as usual, is doing well.

I sent a bunch of Russian red willows to Mr. Ross last spring; that is a fast grower and extremely hardy. It grows well on high, dry land, and on low ground it does better than most of the other varieties.

About eighty-five per cent of the trees in my district are doing well. The demand is growing each year, and is likely to increase pretty fast.

I think it is well to leave most of the names on the list, and to make a special effort to call on the new men and to send a return circular to all we do not see.

A few are talking of planting for fuel and posts, but that will not become general till the farmers are in a better position to give the plantations the necessary care.

Quite a few are asking for evergreens, and when we are in a position to send out a few they will indeed be very acceptable.

I still carry my dibble, and give a good many object lessons, which are always appreciated. Most of the young trees sent out are easily planted with a dibble, and as I find new men imagine it quite a contract to put out even a small plantation, I want to show them what an easy matter it really is.

I think we have reason to be pretty well pleased with our progress so far, but I believe we should be a little more strict as to cultivation both before and after planting, as failure or partial failures can generally be traced to poor cultivation.

Twice during the season I had the pleasure of visiting the nursery at Indian Head, and to spend a day there is a real pleasure. The nursery there is a great credit to our efforts in helping to make the thousands of farm homes in the west.

Your obedient servant,

JOHN CALDWELL.



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## APPENDIX No. 12.

## REPORT OF WALTER GUITON.

DEPARTMENT OF THE INTERIOR,

FORESTRY BRANCH, NURSERY STATION,

INDIAN HEAD, SASKATCHEWAN, December 26, 1908.

R. H. CAMPBELL, Esq.,  
 Superintendent of Forestry,  
 Ottawa, Ont.

SIR,—I have the honour to submit to you my second annual report on tree planting inspection work as carried on through the co-operation of the Forestry Branch, Department of the Interior. The districts assigned to me were:

Main line of the Canadian Pacific Railway, Grand Coulee to Moosejaw.  
 Soo line, Moosejaw to North Portal,  
 Estevan line, Estevan to Gainsboro'.  
 Main line of Canadian Pacific Railway, Moosejaw to Lethbridge,  
 Crowsnest, Lethbridge to Pincher Creek and Cowley.  
 Alberta irrigation line, Lethbridge to Cardston.

There were 640 applicants on my books, 317 of whom were new applicants. Of these 210 are to receive trees in the spring (1909), while the other 107 will be visited next year, when they will have had more time to cultivate.

The total number of trees recommended by me this year will be 452,520 to old and new applicants, numbering 415.

On April 1 I commenced work at the Forest Nursery Station, making cuttings, planting and assisting with the usual spring distribution of trees, until the 15th of June, when I left Indian Head to inspect plantations on the main line of the Canadian Pacific Railway from Grand Coulee to Moosejaw, also the Soo line. During the whole of this time I found trees making a splendid growth. The tops of the cottonwoods were badly killed back last year, from too late a growth, largely due in many cases to cultivation being carried on later than the third week in August.

On the Estevan line, where planting has been carried on for a number of years, I found the trees, which are from 10 to 15 feet high, shading the ground sufficiently to keep down the weeds and cultivation no longer necessary.

From Gainsboro' I returned to Moosejaw, continuing my way west towards southern Alberta at Swift Current, where we have a large number of plantations. I found the trees doing very well, also well protected from stock. While there I inspected the land at the Mennonite village, twenty-three miles southeast of the town, where the settlers have prepared a sixteen-acre strip running the full length of the village on the west side. This will be, when completed, the largest solid block of trees set out under the co-operation of the Forestry Branch, which will demonstrate to the settlers the advantage of shelter. Care has been taken by the department that the trees on this strip are at a sufficient distance from the buildings (360 feet) so that in the future the enlarging of the present buildings would not disturb the trees.

The plantations planted around Maple creek are doing remarkably well considering the small amount of rain which fell during the summer, but by following the rules given by the inspectors as regards cultivation which is carried on during the dry spell, thus retaining what moisture there is in the ground, this disadvantage is greatly lessened.

I also visited the Cypress hills, about twenty-three miles south of the town, to pick jackpine cones, Murrayana variety, which were shipped to Mr. Norman M. Ross at Indian Head.

Leaving Maple creek, I continued my way inspecting along the Crowsnest Railway till I reached Lethbridge, where the trees are grown under two systems. The

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trees grown under the irrigation system are doing very well. The best results seem to be when the water is turned off the second week in July, so that the trees may have sufficient time to ripen before the frost comes. A good plan, which has shown good results, is to irrigate the ground the last thing in the fall, so that the ground when frozen may be thoroughly moist, thereby having a tendency to check the trees from budding out too early in the spring.

To cultivate trees we all know that a sufficient amount of time and labour is required to be spent upon them to keep the weeds from growing, which takes the moisture from the trees. The soil should always be kept in a loose state so that evaporation does not become too rapid. In dry weather evaporation is effectively diminished by frequently stirring the soil which forms a loose, dry, protecting covering for the deeper layers.

The country southwest of Lethbridge is known as the Mormon district. Here tree planting has been carried on for the past eight years. The killing back of the cottonwood was not noticeable here on account of splendid growth this year. The willow cuttings given out by the Department would have attained a bigger and stronger growth if the rules had been more closely followed in regard to planting, not leaving so much of the young cutting exposed.

The percentages of trees living, set out this year are: elm 98, ash 95, cottonwood 90, maple 95, willow 90.

The increase in the number of new applicants is encouraging, as it shows the interest taken by the farmers in the planting of the prairies.

I arrived in Indian Head the middle of October, assisted with the heeling in of the trees for spring distribution, after which I went into the office at Indian Head, making plans and assisting in the general routine of office work.

Your obedient servant,

WALTER GUITON,

*Tree Planting Inspector.*

## APPENDIX No. 13.

### REPORT OF JAS. KAY.

DEPARTMENT OF THE INTERIOR,

FORESTRY BRANCH, NURSERY STATION,

INDIAN HEAD, SASKATCHEWAN, December 26, 1908.

R. H. CAMPBELL, Esq.,

Superintendent of Forestry,

Ottawa, Ont.

SIR.—I have the honour to submit the following brief report on my work as Inspector of Plantations set out under the co-operative system of the Forestry Branch.

I commenced work at Indian Head about the beginning of April, assisting in the distribution of trees and other nursery work, and left Indian Head at the end of June to commence regular inspection work.

The district assigned to me by Mr. Ross was in the northern parts of Manitoba, viz., Glenboro' branch of the Canadian Pacific Railway from St. Claude to Sinclair, the Yorkton branch up to and around Foam Lake, the Miniota, Lenore and Brookdale branches and the main line from Rosser to Kirkella.

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There were 450 applicants to be visited on my list, 115 being new; of these new applicants 92 were promised trees, 23 not receiving trees for various reasons, such as, land not in fit shape to plant trees, being too rough, that is, backsetting not well done, land in grain crops, others having plenty of natural bluff and therefore not requiring trees, &c. In all, 266 applicants were promised trees to the number of 229,100 for the spring of 1909.

With a few exceptions I found the trees set out under the co-operative system making satisfactory progress, the exceptions being due mostly to want of time, help, sickness, or some other unavoidable circumstance.

The following is an approximate percentage of trees living: Ash, 98 per cent; elm, 98 per cent; maple, 95 per cent; cottonwood, 85 per cent; willow, 80 per cent; giving an average of 90 per cent, which I consider very satisfactory.

Many farmers at first are not in favour of ash and elm, owing chiefly to their slower growth, but those that have a larger experience of them prefer to have a good percentage of both ash and elm in the mixture, as they are beginning to realize the fact that these two trees will become useful about the farm later on, and when properly mixed with the maple and cottonwood are quite able to hold their own.

The Manitoba maple and cottonwood are general favourites and have done fairly well in most of the districts I travelled over. They are hardy and give good shelter in a very short time when given proper care and cultivation, both of which are necessary to obtain the best results.

Willows are also giving satisfaction, and when properly planted make a quick, bushy growth and make an excellent hedge for wind or snowbreak, and are also quite hardy.

There were a good many trees damaged by frost last winter (1907) even among the older trees, this being probably due to the late short spring and wet summer, keeping the trees growing late in the fall, with the consequence that the new growth was not properly ripened, therefore was killed back when frost set in, some trees being killed outright, the roots of the latter being probably not so well protected by snow or other covering. The periderm or outer covering on roots is thinner than on stems and consequently the former are less protected, and besides growth is generally active for a longer period on roots, where it frequently continues till well on in winter, so that when frost occurs the tissues are not in the inert condition which assists them to resist cold. Such plants burst their buds in spring, but wither whenever transpiration from the tender young shoots has exhausted the supply of water stored up in the plant.

On the Yorkton branch of the Canadian Pacific Railway, north of Binscarth, the ash were nipped back by a 9th of June frost; the 1908 plants only lost their leaves, but the 1907 growths on older plants were killed back, but afterwards recovered and put on a good growth.

These two examples would tend to show that the condition of vegetation in regard to the season of the year has great influence in the power of a plant to resist frost. It is well known what low temperature a plant can stand during the period of winter rest, whereas in spring after the beginning of vegetative activity, and before it ceases in autumn, it is killed by a few degrees of frost.

There should not be much cutting back by frost this winter, as owing to the dry nature of the summer and fall the trees composing the plantations began to lose their leaves early, thus giving them time to ripen the new wood before severe frost set in.

In some cases the 1907 cottonwoods were disfigured by a rough growth in the twigs, this growth being due to plant lice, viz., vagabond gall (*pemphigus vagabundis*). The galls were not noticeable till they had lost their green colour, turning black in the fall, they were then easily seen. There were a few galls this year, 1908, but not in such quantity as in 1907. Farmers were advised to cut off and burn them while still green, thus destroying the insects inside the galls.

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Pruning seems to be a vexed question with a good many planters, but many of them who have pruned find that it has given them years of extra labour to keep down weeds, and that they would have had better windbreaks and plantations if they had kept their knives off the trees. Pruning the trees of these plantations should be quite unnecessary, as the trees are planted close enough, so that after a few years growth the low branches are shaded, cut off from the light, die and drop off, leaving the stems clean and free from branches. The shade also helps to keep down weeds, and also prevents radiation and consequent evaporation of soil moisture, thus rendering cultivation no longer necessary. Any one can see this for himself in the natural bluffs; the straightest, cleanest and best trees are where they grow thickest.

Pruning is only advisable in the case of ornamental and avenue trees where the lower branches would be in the way. When pruning a branch, care should be taken to cut the branches off as close to the main stem as possible, so that the wound will heal over quickly. If snags are left sticking out they decay, the rot spreads into the interior of the tree, making it of little or no value for anything.

In the districts I travelled over the earlier set out plantations are already affording good protection to buildings, and have enabled farmers to lay out nice gardens and lawns in their shelter, in which gardens they can grow quite a large variety of vegetables, flowers and small fruits. Many farmers are also planting out some of the larger fruit trees, and these when carefully selected, give every prospect of success.

The majority of farmers who are planting take quite an interest in the work, which is demonstrated in the time and work and care they have given the trees received from the Forestry Branch.

Your obedient servant,

JAS. KAY.

#### APPENDIX No. 14.

##### REPORT OF N. B. McDONALD.

DEPARTMENT OF THE INTERIOR,

FORESTRY BRANCH,

INDIAN HEAD, SASKATCHEWAN, January 12, 1909.

R. H. CAMPBELL, Esq.,

Superintendent of Forestry,

Ottawa, Ont.

SIR,—I have the honour to submit the following report of my work as Tree Planting Inspector in connection with the co-operative tree planting of the Forestry Branch. The district assigned to me was in Alberta, the country along the Canadian Northern line from Islay to Edmonton, the Canadian Pacific Railway line from Edmonton to Calgary, including both Wetaskiwin and Lacombe branches, the Calgary-Macleod line as far south as Granum, and the main line from Cochrane to Medicine Hat.

The number of places to visit on my list was 568. To 261 of these trees will be sent, 220 were new applicants, of whom 130 receive trees next spring.

After spending two months and a half in the nursery station at Indian Head assisting with the distribution of trees, spring planting and other work, I started out on inspection work on June 15 via Calgary and visited first the district round Airdrie, Crossfield and Weta-kiwin to note the results at different elevations of some of the older plantations and to see how the cottonwoods had stood last winter.

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The plantations along the Canadian Northern line had not been inspected before, and it was evident that many of the people did not understand the amount of cultivation necessary as a preparation for tree planting, as about fifty per cent of the new applicants had to be deferred for a year, and much of the ground planted in 1908 would have been better for another year's cultivation. In this newly settled country I found a potato crop usually a much better preparation for planting than summer-fallow, as the farmer must have his potatoes anyway and generally gives them good cultivation; while the land to be summer-fallowed is often allowed to stand in the press of work till late in the summer, when the growth of grass and weeds is so great that the main object of summer-fallow, the conservation of the moisture, is entirely defeated.

Conditions were much better in the districts along both the Wetaskiwin and Lacombe branches of the Canadian Pacific Railway. The country here is open and the want of native timber is felt very much. The few bluffs that have escaped the fires are being rapidly cut out, and I even heard of cases where people came twenty miles to cut poles at night on other peoples' farms; so that the owners in self-defence had finally to cut what was left that they might have a little for their own use. The plantations out in these districts are doing well, and as people realize this and their material conditions improve, I have no doubt that there will be a great increase in the demand for trees to plant.

From about Red Deer south, as far as Staveley, and east to about range 25, west of the 4th meridian, I was sorry to find many of the plantations not so satisfactory, having been badly damaged by the frosts of last and preceding winters; the cottonwood, indeed, may be said to be a complete failure. This district is higher than the rest of the country and on this account seems to be subject to occasional early frosts in the fall, and the soil being generally of a rich black loam, the growth seems to be carried on so late that the new wood is not ripe when the frost comes, and more or less damage is the result. This seems to be particularly true of the cottonwood, though in many of the plantations it must be said that the elm, ash and maple have also suffered badly. This season, however, has been more favourable, the wood being fairly well ripened before the first frost and likely to stand the winter.

Russian poplar and native trees, such as the balsam of gilead, balsam and spruce, do well in this district, but few of the people are within reach of the native plants and those who are frequently lift and plant them badly, the roots often being allowed to dry out on the journey from the bush to the farm, and many of the trees never make a start after being planted.

From about Staveley, south and east, all the trees, including cottonwood, are doing well and making good growth.

In the Gleichen and Medicine Hat districts conditions are very favourable. The trees are growing rapidly and ripening early where the soil is lighter.

With a good many people the ash is not a favourite on account of its slow growth for the first two or three years, but its qualities as a tree suitable for planting on the prairie are being well shown in the older plantations; most of the trees being already as high as the maples and making a yearly growth of from eighteen inches to two feet.

The percentage of deaths in the plantations is small, and this should improve as people understand the planting better. Most of the blanks were amongst the willows, caused no doubt by either loose or shallow planting of the cuttings, and in some cases where the outside row was planted too close to the sod the spreading grass roots getting most of the moisture and the plants suffering accordingly.

Your obedient servant,

N. B. McDONALD.

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## APPENDIX No. 15.

## REPORT OF JAMES LEAMY.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS OFFICE,

NEW WESTMINSTER, B.C., January 16, 1909.

R. H. CAMPBELL, Esq.,

Superintendent of Forestry,

Ottawa, Ont.

SIR,—I beg to submit the following report in connection with the preservation of the forests from fire and the work done by the forest fire rangers in the employ of the Department of the Interior, for this purpose, in the railway belt in the province of British Columbia, during the season of 1908, which was an excessively dry one and numerous fires occurred, the suppression of which necessitated the employment of a large number of temporary men, and consequently the expenditure of a considerable amount of money, also constant vigilance on the part of the regularly appointed fire rangers in the various districts.

A fire occurred on Timber Berth No. 29 in Yoho park, which, while causing some anxiety, did not do any damage, being subdued by Ranger Buttwell and some men employed under him. This fire was caused by a survey party who were engaged in surveying this berth.

In Mr. Fisher's district, which extends up the Beaver river, and from Donald to Surprise rapids, on the north boundary of the railway belt, a fire occurred which was supposed to have been caused by lightning, there being no person in that neighbourhood; no damage, however, was done thereby.

In Mr. Ashdown's beat, extending along the Columbia river on both sides from the south boundary of the Railway Belt north to Donald, a number of small fires occurred, and some money was expended in fighting them, but no timber was lost.

A fierce fire raged on provincial land in this vicinity for some time, but did not reach the railway belt, owing to the watchfulness of Ranger Ashdown.

Numerous small fires started along the line of the Canadian Pacific Railway between Glacier and Revelstoke and were attended to by Ranger Kennedy. Up the Loop, near Glacier, a bad fire occurred and did considerable damage by burning a snow-shed on the Loop and extending across the mountain near to the Glacier hotel; a large number of men in the employ of the Canadian Pacific Railway, working under the direction of Ranger Kennedy, succeeded in preventing this fire from doing any further damage than as before mentioned.

Along the branch of the Canadian Pacific Railway running from Revelstoke to Arrowhead a number of small fires occurred, being chiefly caused by sparks from locomotives and by settlers clearing land, but were promptly looked after by the Rangers, Messrs. McRae and Morris, also by the Canadian Pacific Railway sectionmen, therefore no damage was done by them; they principally occurred in old logging works and other debris left from clearing the line of railway.

Through the valley of the Eagle Pass river several large fires occurred, notably one on Limit No. 363, held under license by the Eagle River Lumber Company; this fire it is claimed was ignited by sparks from a logging engine operated by the licensees, and burned over an area of  $1\frac{1}{2}$  square miles, which had, however, been logged off by the company some years ago; it destroyed two logging camps belonging to the company and some logs on skid-ways amounting to 50,000 feet board measure.

The only other fire that caused any trouble in this valley was one which started about one mile south of Malakwa on the Canadian Pacific Railway line. It was attended to by Ranger Lidstone, who got it under control and prevented it from doing damage.

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The largest and most destructive fire that took place in the Railway Belt in British Columbia occurred in the Shuswap Lake district, in the vicinity of Carlin and White lake; it burned over an area of 2 square miles, partly in a logged out section, on Limit No. 239, under license to the Columbia River Lumber Co.; it is calculated that at least six million feet has been affected by this fire and unless logged out within the next two years, will be lost. This fire is supposed to have been partly caused by sparks from a locomotive operated by the Columbia River Lumber Company in hauling lumber from their Carlin mill to the main line of the Canadian Pacific Railway in the immediate vicinity of White lake; the fire was also set maliciously by some person, as the Fire Ranger, Mr. Peacock, discovered that the fire was started in some six or seven places, evidently with the intention of burning up that entire district. This fire was looked after by Mr. D. J. McDonald, Assistant Crown Timber Agent, and Mr. W. R. Peacock, fire ranger in charge of this district, and it is due to their combined efforts that the whole of the peninsula situated between the main Shuswap lake on the north and the Salmon Arm on the south, was not completely burned over and all the timber thereon destroyed. A glance at the map of the Shuswap lake will show this; both of the gentlemen were untiring in their efforts, working day and night supervising the work of fighting this fire.

The fire on Manson creek, in Limit No. 240, on the north shore of Shuswap lake, held under license by the Arrow Lake Lumber Company, was caused by squatters clearing and burning brush; this was likewise a very serious fire, affecting about four million feet of good merchantable timber. A bad feature in connection with this fire is that while the men were fighting and quenching the fire it was constantly being reset by malicious persons, who evidently desired to burn up all the timber in that country. I may say that this fire was also overlooked by Messrs. McDonald and Peacock, assisted by the foreman of the Arrow Lake Lumber Company, the company having sent a force of men from Kamloops to look after it.

Another fire, of no consequence, took place on Limit No. 242, on the north shore of the Little Shuswap lake. I may add further that several small fires occurred on the Big Shuswap lake, which were probably set by Indian campers or others, but they were promptly extinguished by the patrol men stationed along the lake and did no damage.

On the Shuswap and Okanagan branch of the Canadian Pacific Railway small fires occurred in many places but did no damage; one occurred about one mile west of Armstrong on some deeded lands, which was attended to by Mr. Johnstone, Fire Ranger, who succeeded in preventing it from spreading into valuable timber along the Salmon River valley; no loss was occasioned by this fire.

A very large fire took place on Deep creek, which fire was caused by settlers clearing land, and extended over some nine hundred acres of bush; it was looked after by Mr. J. D. McQuire, Fire Ranger, who succeeded in preventing it from extending into the Larch Hill reserve and into Limits Nos. 356 and 402, which would have happened if it had not been properly looked after.

A fire occurred up the Salmon river at Silver creek, which was properly attended to by Mr. J. D. McQuire and assistants; it did no harm, as it ran through timber grass and did not destroy any timber, only requiring constant watching.

In the Skemeekin valley a fire occurred which at one time threatened to destroy the timber on Berths Nos. 428 and 451, but was prevented from doing so by the prompt action of the Ranger, Mr. Peacock.

In China valley a fire started which threatened to destroy timber not yet leased, but nevertheless valuable; this fire was prevented from doing any damage.

In the district covered by Mr. Angus McGillivray, around Ashcroft and along the Nicola valley, several small fires occurred but did not do any damage to standing timber. Along the line of the Canadian Pacific Railway in the vicinity of Hope and Yale some fires started which were attended to by Mr. Teague, whom I engaged to look

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after this district, as it was practically impossible for Mr. Fadden and Mr. Hughes to give proper attention to the large districts in their charge.

On Harrison lake two fires of considerable importance took place, one at Twenty-mile Point on Timber Berth No. 281 started in the month of May; this did no damage but another fire occurred in the same place later in the season, which destroyed about fifty thousand feet board measure of timber. The other fire referred to took place on Timber Berth No. 445, and considerable expense was incurred in fighting it; about sixty thousand feet of saw-logs which were cut and lying in the path of the fire, were destroyed thereby; operations were being conducted on both of these berths at the time the fires took place, and the fires are supposed to have originated from sparks from their logging engines.

In the Cultus Lake district only two fires took place, one of them on a steep mountain side, destroying about 10,000 feet of merchantable timber; the other fire did no damage.

At Abbotsford, in the district covered by Mr. John Ball, a fire of considerable proportions took place, but with the assistance of a number of men Mr. Ball was able to prevent its doing any damage.

At Stave river a fire started on Timber Berth No. 268, under license to the Bank of Hamilton, but operated by Messrs. E. H. Heaps & Company; the cause of this fire is unknown, but with the assistance of a number of men the Rangers, Messrs. Martyn and Gilchrist, were able to prevent its doing very much damage; about two hundred cords of shingle bolts were destroyed by this fire.

Another fire occurred in this district on lands on Timber Berth No. 106, presumably started by a party who was living on land which forms a part of this berth; no damage, however, resulted therefrom.

Along the Coquitlam and Pitt Lake rivers, some small fires occurred, but were promptly attended to by Mr. Marshall, the ranger of this district.

On the North Arm of Burrard Inlet only one fire took place, on a small island on which there was no timber, and I consider that the Ranger, Mr. Jeffrey, must have attended strictly to his duties, this being considered a very dangerous district, owing to the many campers who spend the warm months of the summer in this vicinity.

On the south side of the Fraser river a number of fires took place in the vicinity of Timber Berths Nos. 'B,' 'K,' 'H,' 'R' and 293, but owing to the prompt attention of Messrs. Johnson, Gairns and Jameson, the fire rangers in this district, with the assistance of other men, no timber can be said to have been destroyed.

In the whole Railway Belt, in my opinion, not more than 200,000 feet of merchantable timber was actually destroyed during the season, and I consider this small loss is due to the faithfulness and efficiency of the various fire rangers, who were untiring in their efforts, and who have at all times shown a willingness to perform their duties.

Your obedient servant,

JAMES LEAMY,  
*Crown Timber Agent.*



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## APPENDIX No. 16.

## REPORT OF W. R. McLEOD, CHIEF FOREST FIRE RANGER.

DEPARTMENT OF THE INTERIOR,

DOMINION LANDS AND CROWN TIMBER OFFICE,

PRINCE ALBERT, SASKATCHEWAN, NOV. 19, 1908.

R. H. CAMPBELL, Esq.,  
 Superintendent of Forestry,  
 Ottawa, Ont.

SIR.—Attached herewith you will please find report filled in as requested in yours of the 5th instant.

In further reference to this report I may add that we have had a lot of fires to contend with during the months of May and June principally caused through carelessness on the part of travellers and hunters, in leaving camp fires and lighting pipes, as the grass was very dry and did not require a big spark to start burning; however, with the number of fires I consider that the service was very good and saved many times the amount of expense incurred in checking the fires.

We had two bad fires to contend with, viz., the Shrimp lake fire and another near Mistatim on the Canadian Northern Railway branch. These were practically the only fires where any great assistance was required and any amount of extra expense was incurred.

The last mentioned fire at Mistatim must have been caused by lightning, as there was no person near the starting point.

I believe great assistance could be had from the provincial government if they enforced their laws respecting prairie fires, as I understand all officials of the provincial government are fire guardians, but they will let the prairie fires run unnoticed, and nearly all our fires in timber land come from the prairie.

I believe I am safe in saying that the only damage caused in this district has been to second growth pine, and the total amount damaged would not exceed 1,800 acres. Of course, all the second growth pine was not damaged in this above mentioned radius.

Our timber land is broken with poplar bluffs, and these bluffs assist us greatly in fighting fires, as the fire will not run so fast in the poplar as in spruce and pine.

The system we have found most satisfactory in fighting fires is to work at night when the air is heavy and moist, and dig a trench in suitable places where the fire has too far to jump so as to make it a ground fire. The ordinary garden hoe and wet sacks where water can be had we find to be the most effective.

Your obedient servant,

W. R. McLEOD,

*Chief Forest Fire Ranger.*

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## APPENDIX No. 17.

## REPORT OF INSPECTOR W. CONROY.

DEPARTMENT OF INDIAN AFFAIRS,

OTTAWA, March 31, 1909.

R. H. CAMPBELL, Esq.,

Superintendent of Forestry,  
Ottawa.

SIR,—In compliance with your request I beg to report upon the work done by the fire guardians in northern Alberta for the past year. I might be permitted to state that the work done by them in forest protection has been very satisfactory and a great many fires of long burning were extinguished.

Mr. Samuel Cunningham, who was appointed last spring for Lesser Slave lake, has a very large country to travel over and I was informed by very good authority that he extinguished a number of fires north and south of Lesser Slave lake that had been running for a year or more.

Mr. Duncan McDonald, of Dunvegan, has about 200 miles of the Upper Peace river. He also did a great amount of fire fighting.

I would strongly recommend that the department appoint another guardian from Peace River crossing to Wolverine point, as there is considerable timber fringed along the river which is very valuable. Wolverine point is about 150 miles down the river and would be sufficient for one man to attend to.

If the department would appoint another guardian from Wolverine point to Lachute I think it would be a good thing for the country as the timber is all very valuable. I might say that the Lower Athabaska is well attended to but a man might be appointed for the Upper Athabaska for a hundred miles or more from the mouth of the Little Slave river. Another should be appointed at Grande Prairie, a large tract of country with many bluffs. Big Smoky river would also come within that district.

Your obedient servant,

W. CONROY.

*Inspector Treaty 8.*

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## APPENDIX No. 18.

## CANADIAN IRRIGATION SURVEYS.

REPORT OF JOHN STEWART, D. L. S., C. E.,

*Commissioner and Chief Engineer of Irrigation.*

In the spring of 1908 I sent two engineering parties into the field, one in charge of Mr. R. J. Burley, in Saskatchewan, and the other in charge of Mr. P. M. Sauder, in Alberta. Both these men had instructions to make inspections of all ditches authorized, gauge all streams and make surveys of lands to be purchased under the terms of the irrigation system. Under these instructions Mr. Burley made 101 inspections of schemes authorized, 28 inspections of licensed schemes, 36 surveys of lands to be purchased, 11 transit surveys of ditches and made 66 gaugings of streams in his territory and sent in to this office 160 reports. Not having the new meters until late in the season, he was unable to gauge all streams but made a number of weir measurements of small streams before the meters arrived. Mr. Burley had one assistant for the purpose of gauging streams who also helped in making surveys; outside of the other surveys mentioned above he made measurements of earth removed and an estimate of the cost of the Enright and Strong irrigation scheme, in all 14 miles of ditches.

The second party in charge of Mr. Sauder in Alberta made 26 inspections of ditches authorized, 5 inspections for domestic purposes, inspected 19 applications for water, made 2 surveys of Tide lake and Trout creek, and gauged 37 streams, a total number of gaugings of 152, and set 11 gauge rods and erected 3 cable stations for gauging streams, 5 bridge stations and 3 wading stations. He also inspected 5 licensed schemes. Mr. Sauder had two assistants for gauging streams.

In the past season I have personally inspected the Southern Alberta Land Company's property for the exchange of lands, made a survey of the Canadian Pacific Railway Company's reservoir on Thomas Winter's land at Fleming Station, also inspected the Canadian Pacific Railway reservoir at Moosomin Station, the Indian Head waterworks, Enright & Strong's irrigation scheme, and made a survey of Andrew Gordon's and J. W. Imes' irrigation schemes on the Red Deer river. I inspected the Canadian Pacific Railway works at Elkwater lake, inspected some dry lakes southwest of Saskatoon, for Davidson & McRae, of Winnipeg, the Moosejaw waterworks from Snowdy's springs, Maple creek waterworks from Sauder's springs and gauged Milk river at highwater for Dr. King. I also went over the St. Mary lakes and Milk river schemes with Dr. King and the United States officials.

With reference to the inside work of this office during the past year there have been the following number of communications received and sent out, viz.:

|  |       |
|--|-------|
| Letters received.....                              | 4,235 |
| Letters sent out.....                              | 4,162 |
| Agreements for water received, in triplicate.....  | 31    |
| Applications for water received, in duplicate..... | 43    |
| Plans with applications for water.....             | 86    |
| Right of way easements.....                        | 38    |
| Agreements for supply and use of water.....        | 1     |
| Agreements for construction and maintenance.....   | 3     |
| Transfers of applications.....                     | 4     |
| Transfers of land.....                             | 2     |
| Gauge rod reading (monthly).....                   | 149   |
| Gauge rod (weekly cards).....                      | 567   |
| Right of way plans recorded.....                   | 37    |
| Notice of cancellation of water agreements.....    | 6     |

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|   |     |
|---|-----|
| Notice of transfers of water agreements.....            | 38  |
| Applications to cross-road allowances.....              | 40  |
| Applications for right of way over Crown lands.....     | 31  |
| Notice of applications prepared for publication.....    | 39  |
| Number of certificates under section 20 of the Act..... | 52  |
| Number of certificates under section 33 of the Act..... | 26  |
| Number of final licenses recorded, in triplicate.....   | 38  |
| Number of reports received from Mr. R. J. Burley.....   | 160 |
| Number of reports received from Mr. P. M. Saunder.....  | 52  |
| Number of cards of discharge of streams.....            | 207 |

In a great many of the letters received there were inclosures which had to be recorded in the books of this office and do not show in the number of letters received, and in connection with right of way plans, which are in triplicate, they all have to be compared and checked before registration, which means a lot of work that does not show, also a large amount of blue printing that has to be done and does not show.

### APPENDIX No. 19.

#### REPORT OF RALPH J. BURLEY.

CALGARY, ALBERTA, March 31, 1909.

JOHN STEWART, Esq.,

Commissioner of Irrigation,  
Calgary, Alta.

SIR,—I beg to submit the following report upon the work performed by me, and general remarks regarding the progress of irrigation development in the Cypress Hills district during the past season:—

Camp was set up in Maple creek on May 2, and, as soon as possible thereafter the work of inspection and stream gauging was commenced. This work was carried out on practically the same lines as last year, all inspections and surveys in the neighbourhood of Maple creek being made first, then moving the outfit in an easterly and southerly direction to east end, inspecting all schemes on the north side of the hills and then moving west, covering the territory along the south side as far as Eagle Butte and Medicine Hat. Owing to the heavy snow-storm on October 21 and 22, it was impossible to make any inspections north of Tenmile Police Detachment and west of Maple creek, excepting those made in the spring and summer on special trips.

In connection with this inspection work some eleven of the longest ditches were traversed by transit with the idea of carrying on this work in future in such a way that it will not take too much time from the actual work of inspection until the department has in its possession accurate maps of all schemes licensed or authorized. While such work takes considerable time, it will, I think, save much trouble in the future regarding right of way, and many difficulties between the settlers themselves will be avoided if each man's rights are definitely known.

During the past season, progress, in many instances, has been slow owing to various causes, such as a misunderstanding regarding the dipping regulations, and the dry season, causing great difficulty in working the ground and necessitating such long hauls for hay and so unduly prolonging the time necessary to put up sufficient feed for stock.

The question of obtaining hay and fodder for stock is being brought to the attention of the ranchers more forcibly every year as the district becomes more closely

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settled, because the government lands bearing hay are becoming, in many places, very inadequate to supply the demand and it seems that irrigation, used to increase the yield of grass, is the only remedy. The effect of irrigation was strikingly illustrated at Messrs. Enright and Strong's last summer, where, on the upper side of the ditch there was a sparse growth of grass perhaps three inches long and on the irrigated land the bluejoint grass, timothy, alfalfa, &c., were very thick and reached a height of two to three feet. Where such results can be obtained in a dry season like last summer by use of irrigation it must be apparent that it is to the interest of the rancher to complete his works at the earliest possible date.

The conditions of climate and soil in many portions of the Cypress Hills district appear to make it particularly adaptable to irrigation and, although still in its infancy, as regards actual work accomplished, enough has been done to show that under intelligent management the best results may be anticipated. Mr. H. H. Fanquer, near Maple creek, who has been working out his irrigation system for some thirteen years, has demonstrated, year after year, that practically all garden products which can be grown in Ontario can be brought to perfection here, and there are other men who are experimenting along different lines, whose work is beginning to show the possibilities of irrigation in this portion of the semi-arid belt. The long hot days and warm nights appear to produce a condition extremely favourable to growth when the necessary water can be applied.

## HYDROGRAPHIC WORK.

This work was carried out in conjunction with the inspections, but as there was practically no snow in the hills during the preceding winter and very little rain during the summer the majority of the creeks went dry during the month of August and part of July. All creeks were measured where possible and eight gauging stations established on some of the more important streams. Several more stations should have been established but owing to the lack of cables and chain gauges and to the fact that most of these other streams were dry last fall it did not appear advisable to expend the time obtaining and transporting such supplies until next season's work commenced, and as there were a great number of inspections pressing for attention this work had to be deferred. My assistant, Mr. Fletcher, started out on a second round of the hills, in October, with instructions to make gaugings of all the streams but was unable to proceed further than Bear creek on account of the heavy snowstorms on the 21st and 22nd.

This work in the Cypress hills is very important, but is rather difficult to carry out owing to the fact that practically all streams over a very large area are in flood at once and rise and fall very rapidly, making necessary the selection of stations where the cross-section is as nearly as possible constant and taking observations for an extended period of years, as it is impossible for any man to cover more than a very small portion of the district during high water.

This work should be greatly extended and carried on systematically over a long period of years as, with the present information on file, it is often very difficult to report on the feasibility of an irrigation scheme, for, although the drainage area may be estimated, practically nothing is known regarding the run-off per square mile, amount of rainfall, slopes of watersheds and amount of timber on watersheds, all of which factors materially affected the flow of water, and this information can only be obtained by careful observation and surveys carried on over a long period. While this work is important in any district it is of special interest in the Cypress hills, where the peculiar conditions of stream flow and the necessity of utilizing all available water for irrigation purposes make it imperative that all available information should be obtained as quickly as possible so that this department will be in a position to advise irrigators as to the best method of conserving and using the water. A condition which is very noticeable on many of the streams is the sinking of the water in the gravel and its reappearance at a point miles down the stream bed, leaving a long stretch dry

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excepting during flood seasons. Unless this condition is pretty thoroughly investigated it may cause trouble regarding the use of water in case an applicant on the dry portion of the stream holds a prior right to one above him and should demand that his amount of water be allowed to pass. Such action would be very unfair, as the water would not reach him in any case and the applicant with the second right would be deprived of the use of the water, which would merely be wasted.

An important factor which must be taken into consideration in the near future is the issuing of licenses against the various sources of supply. As at present carried on it means that when the total flow of the tributaries has been granted no water will be left in the main stream for the applicants along that portion of the stream. A careful definition of the watersheds of the main named creeks and the granting of licenses against the watershed, rather than against the stream would appear to overcome the difficulty, but unless each watershed were very clearly defined it would probably result in considerable confusion.

Another matter which has, so far, attracted no attention but which may be the source of considerable trouble in the future is the granting of licenses against high and flood water. At present licenses are granted for flood water on the same lines as for low water, viz., one second foot for each 150 acres to be irrigated. This gives no chance for reservoiring water during flood periods, and if this amount of water is necessary when the stream flows all the time it would appear that the license should be granted on such a basis as to allow for a steady flow of this amount of water during the irrigation season. This must be arrived at by careful determination of the average duration of high water as well as its amount. There is very little doubt that this matter must be taken up in this district before long on account of the large number of flood schemes being constructed.

Another subject which may have to be considered is the diversion of water from one watershed to another. At the present time I know of only one case where this is being done and this is only a small scheme, but I am informed that it has been a matter for serious consideration in the United States and that it is not allowed in many places. The difficulty appears to be that the seepage from the irrigated land does not return to its own watershed and this water, which otherwise would be of use lower down the creek, is lost to the other residents.

#### RESERVOIRS.

The question of reservoirs is one which is already attracting a great deal of attention and which, from the nature of the water supply, must be of increasing importance as settlement increases throughout this district. Almost all the creeks flowing north from the Cypress hills empty into lakes and sloughs between the railway and the Sand hills, and as these are too low to be of any practical use for storage purposes from an irrigation standpoint the flood water is wasted. In the season of 1902, Mr. C. H. Ellacott, C.E., made very careful contour surveys of reservoir sites on the following locations:—

- Sections 4, 5 and 9, 11, 22, 3 to supply Skull creek.
- Sections 4, 8 and 9, 10, 25, 3 to supply Hay creek,
- Sections 18, 10, 25, 3 and 3, 10, 26, 3 to supply Maple creek,
- Sections 7, 8, 17 and 18, 10, 26, 3 to supply Maple creek.

But no further action was taken regarding them and it is probable that most of the lands included have been otherwise disposed of before the present date. The work of constructing dams, ditches, &c., in these cases was usually too great to be performed by individuals without considerable monetary loss, and although it would be of great benefit to all residents on the creeks no efforts have been made to carry on the work, owing probably to lack of organization amongst the settlers.

Further surveys of this nature would undoubtedly demonstrate the feasibility of storage reservoirs along almost every creek flowing north from the hills, while

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on the south side, there appears to be a very fine natural reservoir in Cypress lake. A careful survey of this lake should be made in the near future to demonstrate its usefulness as a reservoir, taking into consideration the feasibility of diverting water from Battle creek at flood water and using this water to supply both Battle creek and the Frenchman river. It will also, probably, be found when further surveys have been carried out that several small reservoir sites can be obtained to the north and west of this lake, which could be used as feeders, but their utility may be doubtful because of the fact that most of this water must ultimately reach Cypress lake in any case.

Along Middle Fork creek there are several good reservoir sites but there is only one undisposed of, which appears upon casual inspection to be easily constructed. This site is situated in township 5, range 1, west of the 4th meridian and could be made to supply the majority of the irrigation schemes along this creek.

Along Lodge creek I do not know of any suitable site, but there is very little doubt that a survey for this purpose would prove that there are several suitable locations for reservoirs, which will be very necessary for successful irrigation along this creek.

Along the other creeks flowing south from the hills it is doubtful if any large sites could be obtained owing to the rapid fall in the country and it is probable that most of the reservoirs must be constructed by individual irrigators to supply themselves, but a system of surveys would demonstrate to them the possibility of such storage scheme.

Attached hereto is a schedule showing the inspections, surveys and traverses made during the past season.\*

Your obedient servant,

RALPH J. BURLEY

\* Not printed

## APPENDIX No. 20.

## REPORT OF P. M. SAUDER.

March 31, 1909.

JOHN STEWART, Esq.,  
Commissioner of Irrigation,  
Calgary, Alta.

SIR,—I beg to submit the following report of work performed by me during the season of 1908 :—

As almost all the ditches in my district had been inspected during the latter part of the season of 1907, I did not spend much time on inspections, except those in connection with the purchase of land under the irrigation regulations, until after mid-summer.

The measurement of the discharge of streams completed during the previous years served to give a fair approximate idea of the volume of discharge in the different streams in southern Alberta, at the different stages, and it was quite evident in beginning operations this season, that isolated measurements would add little to the information already obtained. Special effort was therefore directed to establishing gauging stations, and in making systematic and continued measurements of the more important streams.

Towards the end of April, a camp was organized at Calgary and Messrs. H. R. Carscallen and H. C. Ritchie engaged as field assistants. Gaugings were first made in the vicinity of Calgary and gauging stations established on the Bow river, Elbow river and Jumpingpound creek. Early in May we moved southward and made discharge measurements of Fish creek, Sheep creek, Highwood river and their branches.

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Bridge stations were established on the north branches of Sheep river, near Millarville, and on the south branch of Sheep river near Black Diamond. Arriving at Nanton on May 30, we were unable to proceed further by trail on account of the heavy rains, so Mr. Carscallen and myself returned to Calgary by train and gauged the Bow, Elbow and Highwood rivers in flood, and afterwards accompanied you to Milk river. In the meantime the camp proceeded to Macleod, where a short delay was necessitated owing to the damage done to the bridge by the floods. I joined camp at Macleod and finding that the floods had changed the gauging station there and so damaged it that reliable results could not be obtained, proceeded to the station on the Belly river, near the Royal Northwest Mounted Police detachment at Big Bend, and found that that station had also been seriously damaged by the floods. The camp was then moved on to Kimbal on the St. Mary river, while Mr. Carscallen and myself made a trip to Milk river and gauged the main stream and the two branches, at points near the junction of the two branches. After gauging St. Mary river, Lee creek and Belly river, we returned to Macleod.

At Cardston we received the new meter and on reaching Macleod I started Mr. Carscallen out with a team, aneroid, instruments and one helper to make discharge measurements of the various streams between Macleod and Calgary and in the vicinity of Calgary. I myself proceeded to Brooks station, where I organized a small camp and ran levels from Tilley station to Tide lake to ascertain the elevation of the latter.

In the meantime Mr. Ritchie took charge of the main camp and, moving to the South Fork river, made discharge measurements of the various streams in that locality.

About the middle of July, I again joined the main camp and, after making some inspections in the vicinity of Pincher creek and Cowley, moved camp to Macleod and thence to Willow creek and Nanton. After establishing gauging stations on Muddy-pound creek, Trout creek, Mosquito creek and Willow creek and making some inspections, we moved camp to the Waterton lakes.

A cable station was established on the Waterton river, near the outlet of the Waterton lakes, and some inspections and gauging made in the vicinity of the lakes. Completing the work in the vicinity of the Waterton lakes about the end of August, we again moved camp to Kimbal on the St. Mary river and made gaugings of Lee creek, St. Mary river, North Branch of Milk river and the Alberta Railway and Irrigation Company's canal.

On September 1, having completed the work in the vicinity of Kimbal, Mr. Ritchie again took charge of the camp and proceeded to a point on the Oldman river, north of Cowley, where he erected a cable station and made various gaugings in the vicinity. In the meantime I made a trip down Milk river to Pendant d'Oreille and across to Pakowki lake, and made various inspections in that locality. I again joined camp near Cowley on September 16 and after completing the inspections and gaugings in that locality moved camp to Macleod and thence to Calgary, reaching here on the 30th. Camp was disbanded and the men paid off on October 3.

After leaving camp at Macleod on July 8, Mr. Carscallen made regular discharge measurements at the gauging stations between Calgary and Macleod and in the vicinity of Calgary until the season's work was ended on October 3. In August, he made a trip up the Crowsnest Pass as far as Coleman, where he made a number of isolated measurements on the Crowsnest river and its tributaries. He also made a round of the gauging stations on the Waterton and St. Mary rivers in September.

After making an inspection of the dam erected by the Blindman River Power Company in the outlet of Gull lake early in October, I went to Saskatchewan and made several examinations of applications for water rights and to purchase lands under the irrigation regulations in the vicinity of Gull lake, Swift Current and Herbert.

During the month of November I made a number of inspections in that part of my district lying between Calgary and Claresholm and west of the Calgary and Edmonton Railway.



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The past year has been a very prosperous one in southern Alberta. Crops have been good and the stock has done well. The water used in irrigation has been largely devoted to the growth of fodder crops, hay being the chief consideration in connection with stock raising, in which a large number of the ditch owners are engaged.

Much of the success of future irrigation development will depend upon a correct estimate of the water supply available for irrigation and the permanency of this supply. Frequently applications to purchase lands under the irrigation regulations cannot be dealt with for a considerable time, and, sometimes, not at all, owing to insufficient information as to the water supply. In dealing with schemes which will have to depend entirely on high water and flood stages, it is very important that some definite knowledge of both the quantity of water at these stages and the probable duration of those stages, should be known.

On the information furnished by the government on the water supply, will depend to a very great extent, the development of water-power in Canada. It only takes a few days to locate a good power site and determine the amount of power which can be developed when the water supply is known. Very often the engineer has to spend a year or more making observations of the discharge of a stream before he can make any estimate of the water-power.

While our irrigation laws in general have some very excellent and superior features, the present method of recording licenses is unsatisfactory and if continued will make an adjudication of the water rights on the different streams necessary. This is most undesirable and should, if possible, be avoided. It is evident to any one looking into it, that the granting of a license on a tributary affects the main stream. Following the present practice, water rights will ultimately be granted for the total flow of all the tributaries of certain streams and licenses on the main stream itself will have no protection. Recording the water rights against the catchment basin, or drainage area, rather than against the streams comprising it, would, I think, be the better practice.

Under the present method of granting water rights, the holder of a highwater or flood license does not get the same quantity of water per acre as the holder of a low water license. He is permitted to divert water at the same rate per second as the holder of a low water license, but the period during which he may divert it is only a short one, whereas the holder of a low water license may divert during the whole season. If the holders of high water or flood licenses were permitted to divert water at a higher rate per second, they could store the extra amount of water diverted in reservoirs and use it during low water stages of the stream when they cannot divert from it.

Your obedient servant,

P. M. SAUDER.

APPENDIX No. 21.

HYDROGRAPHIC SURVEYS.

(Appendix to report of Superintendent of Forestry.)

EXTRACTS FROM A REPORT OF P. M. SAUDER, ON THE HYDROGRAPHIC WORK OF THE UNITED STATES GEOLOGICAL SURVEY AND THE NECESSITY FOR THE ORGANIZATION OF SIMILAR WORK IN CANADA (JANUARY, 1908).

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of the conditions affecting the behaviour of water from the time it reaches the earth as rain or snow until it joins the oceans or the great navigable rivers. These investigations became a distinct feature of the work of the survey in the fall of 1888, when an instruction camp was established at Embudo, New Mexico. The first specific appropriation for gauging streams was made by the Act of August 18, 1894, which contained an item of \$12,500 'for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semi-arid sections.'

Since that time the appropriations have been gradually increased, as shown by the following tables :—

|           |           |
|-----------|-----------|
| 1895..... | \$ 12,500 |
| 1896..... | 30,000    |
| 1897..... | 50,000    |
| 1898..... | 50,000    |
| 1899..... | 50,000    |
| 1900..... | 50,000    |
| 1901..... | 100,000   |
| 1902..... | 100,000   |
| 1903..... | 200,000   |
| 1904..... | 200,000   |
| 1905..... | 200,000   |
| 1906..... | 200,000   |

As a result of the increased appropriations the work has been greatly extended and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States in districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning the river profiles, duration and magnitude of floods, water-power, &c., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gauging stations are established. The selection of a site for a gauging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow ; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gauging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements serve as bases for estimating the flow at other points in the drainage basin.

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Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is in general impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one state this work does not properly fall within the province of the state authorities. The United States Geological Survey has, therefore, by means of the appropriations of Congress, for several years systematically made records of stream flow, with the view of ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behaviour. When a record that is sufficient for this purpose has been obtained for any stream the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States. In addition to these records data in regard to precipitation, evaporation, water-power and river profiles, were obtained in many sections of the country.

These data have been assembled by drainage areas, and are published in a series of water-supply and irrigation papers, each of which pertains to the surface water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data, and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, &c. The records at most of the stations discussed extend over a series of years.

## FIELD METHODS OF MEASURING STREAM FLOW.

Streams may be divided with respect to their physical conditions into three classes: (1) Those with permanent beds; (2) Those with beds which change only during extreme low or high water; (3) Those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data upon which these determinations are based and the methods of collecting them are, however, in general the same. \* \* \* \* \*

## VELOCITY METHOD OF CALCULATING STREAM FLOW.

The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors, the mean velocity and the area of the cross-section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above and below the gauging section. The area depends upon the contour of the bed and the fluctuations of the water surface. The principal way of measuring the velocity of a stream is by current meters.

Great care is taken in the selection and equipment of gauging stations for determining discharge by velocity measurements in order that the data may have the required degrees of accuracy. They are located as far as possible where the channel is straight both above and below the gauging station; where there are no cross-currents, backwater or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gauge height shall be an index of the discharge.

Certain permanent or semi-permanent structures usually referred to as equipment are generally pertinent to a gauging station. These are a gauge for determining the fluctuations of the water surface, bench marks to which the datum of the gauge is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at

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bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

Many kinds of current meters have been constructed; they may, however, be classed in two general types, those in which the wheel is made up of a series of cups, as the Price, and those having a screw propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current meter measurements may be made from a bridge, a cable, a boat or by wading, and gauging stations may be classified in accordance with such use.

In making the measurement an arbitrary number of points are laid off at which the velocity and depth are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gauge section into strips. For each strip or pair of strips the mean velocity, area and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply. Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point and integration. \* \* \* \* \*

#### OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds, the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring the flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficient to be used in its application depends upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross-section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends upon the following law of flow for open, permanent channels: (1) The discharge will remain constant so long as conditions at or near the gauging stations remain constant; (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected; the discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements using gauge heights as ordinates, and discharges, mean velocity and area as abscissas, will define curves, which show the discharge, mean velocity and area corresponding to any gauge height. For the development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

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The form of the mean velocity curve depends chiefly upon surface slope, the roughness of the bed and the cross-section of the stream. Of these the slope is the principal factor. In accordance with the relative changes of these factors the curves may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gauging station, the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighed in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half-tenth on the gauge is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the determinations of flow are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, discharge measurements should be made every two or three days and the discharge for intervening days obtained either by interpolation modified by gauge height or by Professor Stouts' method, which has been described in full in the nineteenth annual report of the United States Geological Survey, Part IV., page 323, and in the *Engineering News* of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

## EXPLANATION AND USE OF TABLES.

For each regular gauging station are given as far as available the following data:—

1. Description of station.
2. List of discharge measurements.
3. Gauge-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gauge height, the area of cross-section, the mean velocity and the discharge in second feet.

The table of daily gauge heights gives the daily fluctuations of the surface of the river as found from the mean of the gauge readings taken each day. The gauge height given in the table represents the elevation of the surface of the water above zero of the gauge. At most stations the gauge is read in the morning and in the evening.

The discharge measurements and gauge heights are the base data from which the other tables are computed. In case of extensive development, it is expected that

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engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed and, if necessary, revised when additional data are available.

The rating table gives the discharge in second feet, corresponding to various stages of the river, as given by the gauge heights. It is published to enable engineers to determine the daily discharge in case this information is desired.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

## DISTRICT HYDROGRAPHER.

As above intimated the work has been systematized by the adoption of standard methods and by grouping the States in districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources. Mr. Follansbee, with whom I spent a week, has in his district about seventy gauging stations, scattered over Montana, and the northern part of Wyoming.

His office is located in Helena, where he receives regularly reports from the gauge height observers and his assistant hydrographers and has a record of all the data and facts collected in his district. Recent information is always available at his office even before it appears in the departmental reports.

The gauge height observer is required to mail weekly reports and to enter his observations in a book which he sends in every three months. The book is examined and if satisfactory the amount due the observer is forwarded to him and the book filed for reference.

Mr. Follansbee has two assistant hydrographers, one of whom makes the gaugings in the northern part and the other in the southern part of his district. Each assistant hydrographer makes regular discharge measurements, at each of the gauging stations assigned to him. While making the gauging he checks the gauge height and makes a memorandum of any data which may be useful or interesting to the Hydrographic Survey. As soon as convenient after the gauging has been made, he computes the discharge and forwards a 'Report of Discharge Measurement' to Mr. Follansbee. As soon as the assistant hydrographer has filled his current meter note-book and has made the computations, he sends it to Mr. Follansbee, who checks it and files it for reference.

Mr. Follansbee plots a gauge height-discharge curve, a gauge height-mean velocity curve and a gauge height-area curve for each station, and when an assistant hydrographer sends in his report of a discharge measurement, he plots the data on these curve sheets.

If the points do not plot in the old established curves he at once endeavours to ascertain the cause. When the cross-section changes, the point will not plot on the established curve on the gauge height-area sheet; when the slope changes, the point will not plot on the established curve on the gauge height-mean velocity sheet; and when the current meter is out of order, the point will not plot on the established curve on the gauge height-discharge sheet. When the point does not fall on the established gauge height-discharge curves for several stations and the points on the gauge height-area sheets fall on the established curves, it is evident that the meter is not in order and requires rerating. If it is found that the slope or cross-section at a gauging station has changed, new curves must be plotted for that station.

When making a discharge measurement the hydrographer always checks the gauge-height, and if he finds it has shifted he corrects it and reports the particulars. Mr. Follansbee then corrects the gauge-height observations over the period between the last two discharge measurements, accordingly.

Mr. Follansbee visits as many of the gauging stations himself as he can during the year, inspects the gauge height and equipment and makes a discharge measurement himself. He also spends considerable time in locating and installing new stations.

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During the winter when gauge height observations and discharge measurements are discontinued at many stations he prepares the gauge height tables, rating tables, the tables of monthly and yearly discharges and run-off, and in some cases tables showing discharge and horse-power and the number of days during the year when the same is available. These tables he sends to Washington to be embodied in the annual report of the survey.

Realizing the importance of the hydrographic work in the advancement of the country, the railways are assisting the work to a great extent by the provision of free transportation for each hydrographer and his helper.

I found Mr. Follansbee and the other United States officials whom I met very courteous and obliging, giving me as much information as they could and demonstrating their methods as far as possible. With Mr. Follansbee I visited several gauging stations, and by assisting in making discharge measurements got a good insight into the work.

## HYDROGRAPHIC WORK IN ALBERTA AND SASKATCHEWAN.

In accordance with instructions to gauge streams in my district, this work has been done as far as possible, but as the gaugings made give the discharge for one day only the information obtained is not of much value for practical purposes. Gauging stations should be established and discharge measurements made at the different stages of the streams in order that gauge height-discharge, gauge height-mean velocity and gauge height-area curves can be plotted, and rating and discharge tables prepared.

The department's irrigation report for 1902 includes twenty-four diagrams showing rise and fall of certain streams in Alberta and Saskatchewan. These diagrams would be useful if they could be applied to gauge height-discharge curves or to a rating-table, but there is no information given as to the discharge of any of these streams at any given gauge height. They give no information whatever as to the quantity of water in the stream at any given time. The same report gives a statement of the quantity of water available, the quantity recorded and the quantity still available for irrigation purposes for many streams. The information in that statement was obtained from a few miscellaneous discharge measurements and cannot be relied upon. Systematic gaugings must be carried on continuously for a period of eight or ten years in order to get reliable information about any stream.

Hydrographic work has from time to time been taken up in a desultory manner, with the result that the information and data obtained have not been as reliable and beneficial as they should have been had a satisfactory system been commenced and followed up.

In order to carry on the hydrographic survey properly, a special appropriation should be made for it and one man with a small staff should devote all his time to the work. If the irrigation belt were divided into three hydrographic districts, namely: Maple Creek, Macleod and Calgary, with one hydrographer operating in each district, the work could be carried on systematically and thoroughly.

The Maple Creek district would include the following streams:—

Battle creek, east and west branches of Bear creek, Belanger creek, Maple creek, Piapot creek, Ross creek, Skull creek, Seven Persons creek, north and south branches of Swift Current creek, Big Plume creek, Little Plume creek, Miry creek, Boxalder creek, Frenchman river, north fork of Frenchman river, Gap (or Fish) creek, McKay creek, Lodge creek, Middle creek, Fairwell creek, Bridge creek, Cottonwood creek, Hay creek and the South Saskatchewan river.

The Macleod district would include the following streams:—

Beaver creek, Belly river, Boundary creek, Callum creek, Connelly creek, Heath creek, Indian Farm creek, Lee creek, Mahmee creek, Muddypound creek, Milk river, Oldman river, north fork or Oldman river, South Fork river, Crowsnest river, Pincher creek, St. Mary river, Trout creek, Todd creek, Cow creek, Willow creek and Waterton river.

The Calgary district would include the following streams:—

Bow river, Elbow river, Fish creek, north fork of Fish creek, south fork of Fish creek, Highwood river, Jumpingpound creek, Little Bow river, Mosquito creek, Nanton

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creek, Nose creek, Pine creek, Rosebud river, Sheep river, north fork of Sheep river, south fork of Sheep river, Kananaskis river, Pokisko creek, Stimson creek and Red Deer river.

The chief hydrographer could be stationed at Calgary, and his duties would be similar to those of Mr. Follansbee at Helena. He could see that the gauge height observers reported regularly, plot the returns from his assistants in the gauge height-discharge, gauge height-mean velocity and gauge height-area curves and direct the operations of his assistants.

As the office work would not be very heavy, and the Calgary district is not very large and easy to work, he could do the gauging in that district himself.

During the winter months when most of the gauge-height observations and discharge measurements would be abandoned, rating and discharge tables could be prepared, the data and information compiled to be embodied in the annual report.

Each hydrographer should be provided with a Price Patent Electric Current Meter for ordinary streams, a small Price Acoustic Meter for small streams, an engineer's level, a levelling rod, a compass, a steel tape, a team and democrat. An engineer on hydrographic work only requires one helper and as the country is becoming fairly well settled he does not require a camp. There is no difficulty in getting accommodation for two men almost anywhere. A camp means travelling with a wagon, which of course cannot cover as much ground as a team and democrat. The running expenses of a camp, which include the wages of a cook and a teamster, are greater than the expenses of two men and a team putting up at stopping houses. Then when it is considered that two men without a camp can cover more ground than a party with a camp it is evident that the camp is not economical.

The district hydrographers need not be graduated engineers but capable men with two or three years' experience in engineering and surveying. As the season advanced it is likely the helpers could be dispensed with and during the winter the services of at least one of the district hydrographers could be dispensed with.

As you are aware, the following resolution was submitted and carried at the recent irrigation convention in Calgary:—

Whereas the permanency of all irrigation development is dependent upon an accurate knowledge of the location and quantity of water supply available; and,

Whereas, the matter of the topographical and hydrographical surveys to determine the location and quantity of such water supply and the proper methods of conserving it must be undertaken by the governments administering the law relating to the use of such water;

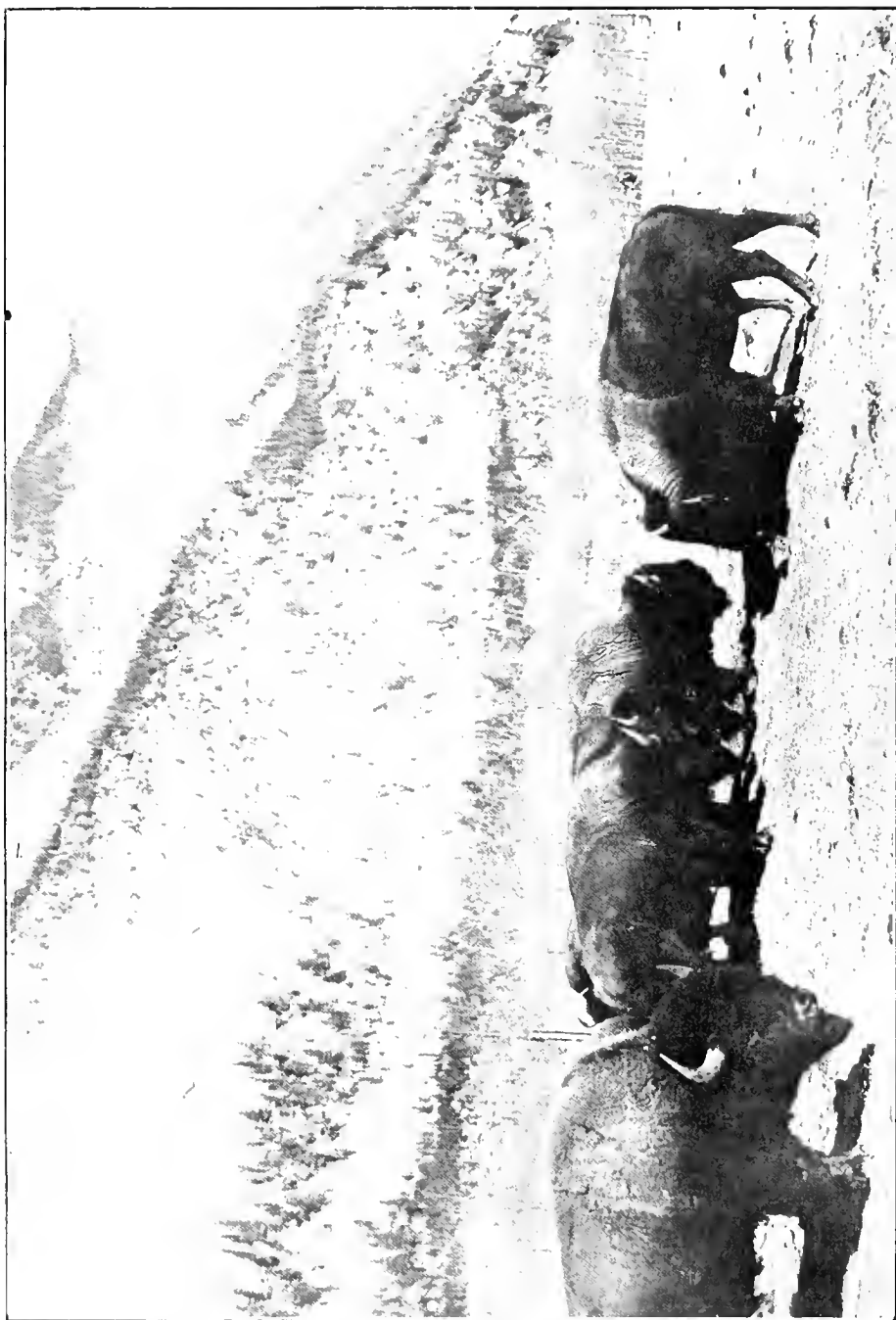
Therefore be it resolved, That this convention, while recognizing the work already done, urges strongly upon the Dominion government and the government of British Columbia the importance of making the necessary appropriations and providing the necessary staff to undertake in an intelligent and systematic manner, the gauging of all streams of water supply and the location and survey of all sites suitable for reservoirs for the storage of water.

The results of stream measurements would prove many irrigation and power schemes feasible which at present will not be touched on account of lack of information. There would be many more storage schemes for irrigation if the people knew the amount of water going to waste during the flood stages of the streams.

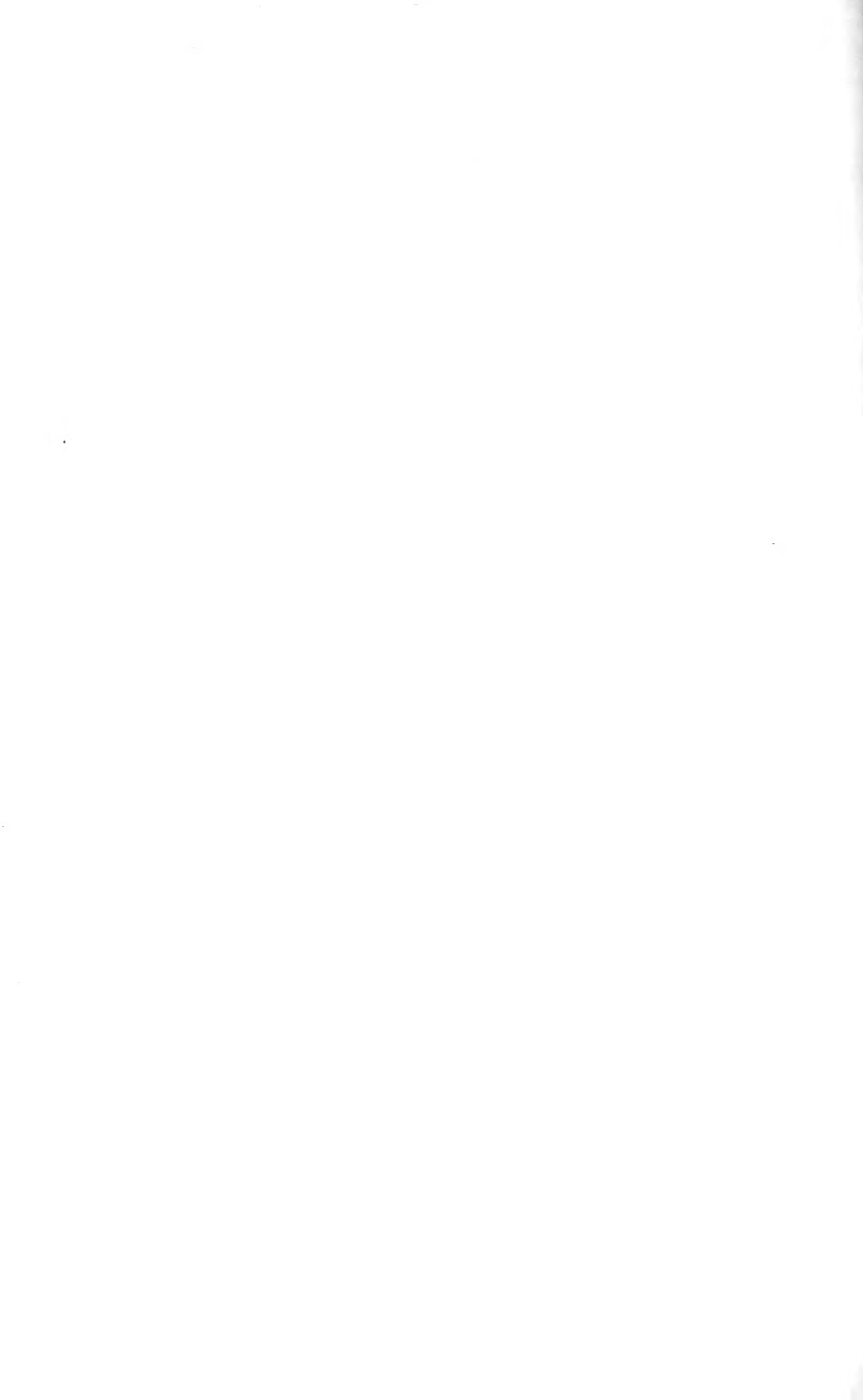
Engineers in the hydrographic survey in the United States claim that many industries have sprung up as a direct result of the information supplied by the hydrographic survey and there are doubtless many power schemes in Canada which will eventually be developed, but at the present time capitalists are slow to invest in such schemes owing to so little information as to the quantity and the permanency of the water supply. This information would also settle any questions arising in connection with water supply and sewage disposal in towns and cities.

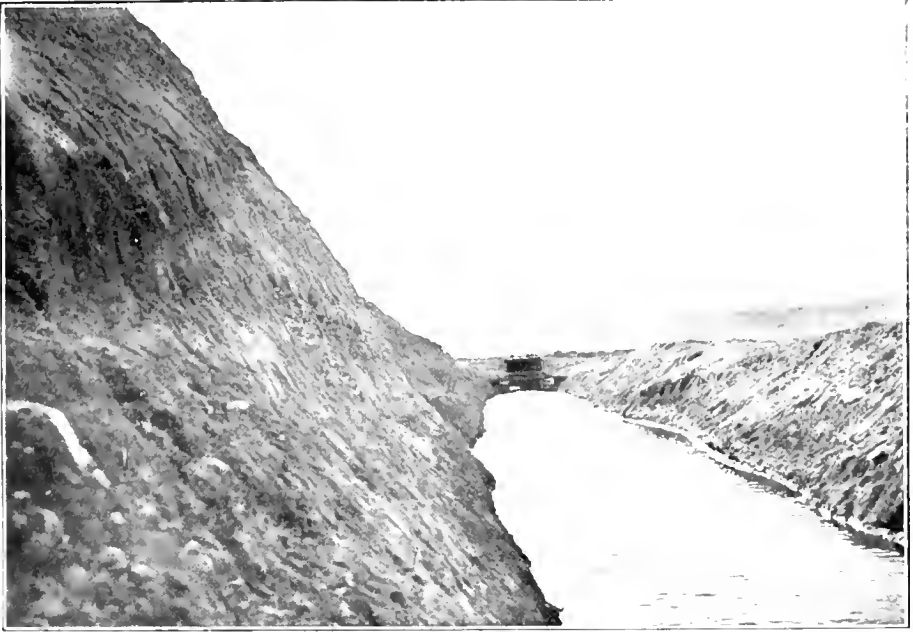
The hydrographic work need not be confined to southern Alberta and Saskatchewan but might with advantage be extended over the greater part of Canada. Owing to the extensive surveys for irrigation in British Columbia, information will soon be required there as to the quantity and permanency of the water supply.





Buffalo at Banff.



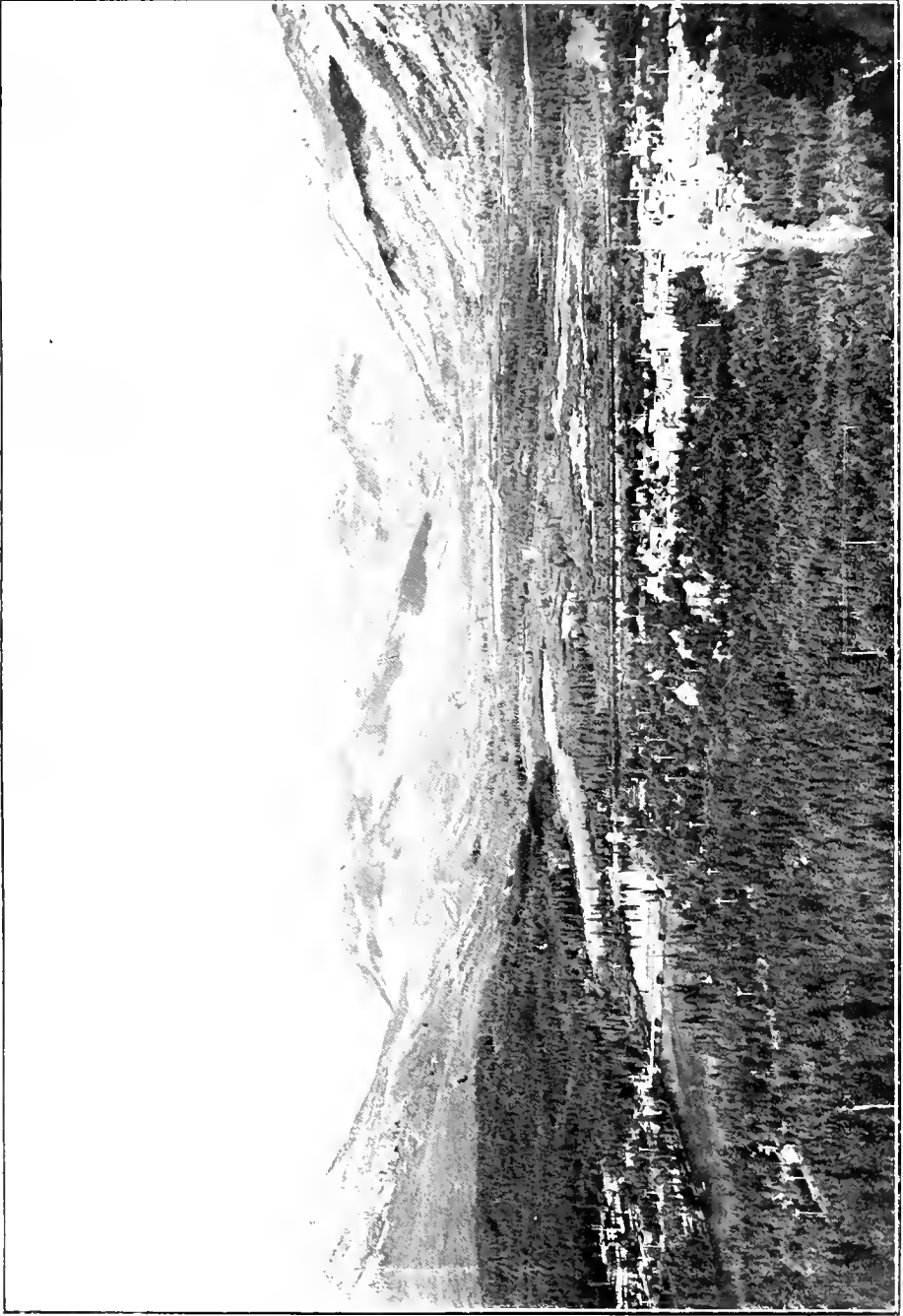


Thirty-five foot cut for Ditch, East End, Sask.



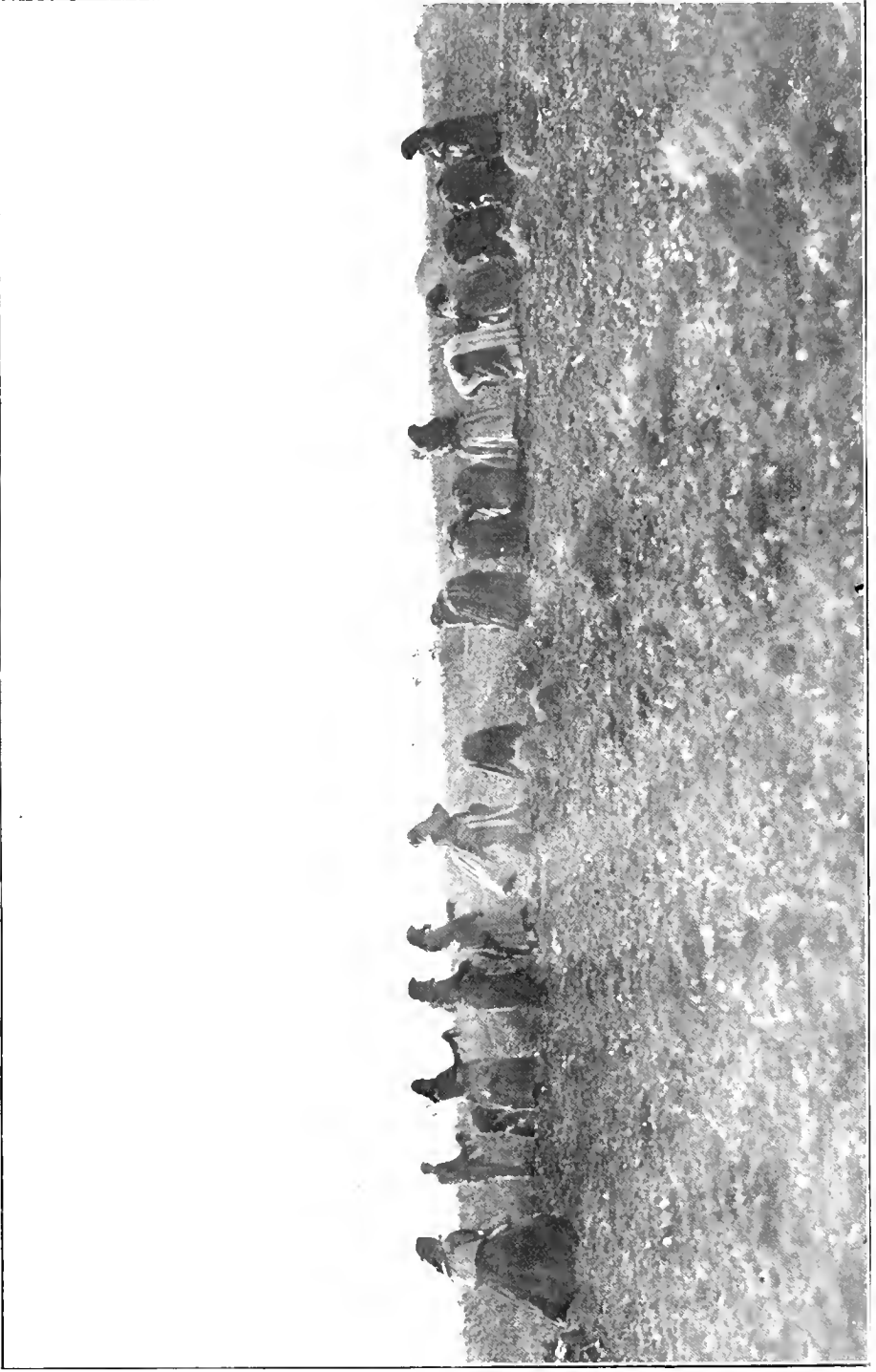
A Forest Fire in British Columbia





Town of Kanif from Tunnel Mountain.





Women pulling and bundling young trees in autumn. Forest Nursery Station, Indian Head, Sask.







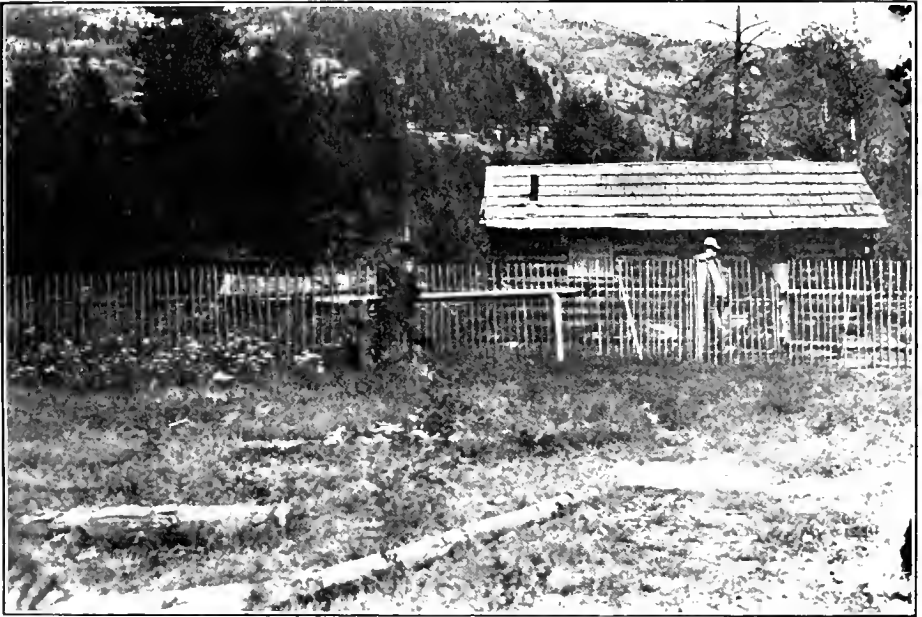
Fire Ranger Gladstone putting up fire notice.





Wheat on Irrigated ground, East End, Sask. — Enright & Strong Irrigation scheme.





Squatter's Cabin on a British Columbia Forest Reserve.



"Heeling in" young trees in autumn. Forest Nursery Station, Indian Head, Sask.





Interior of Seed House, Forest Nursery Station, Indian Head, Sask.





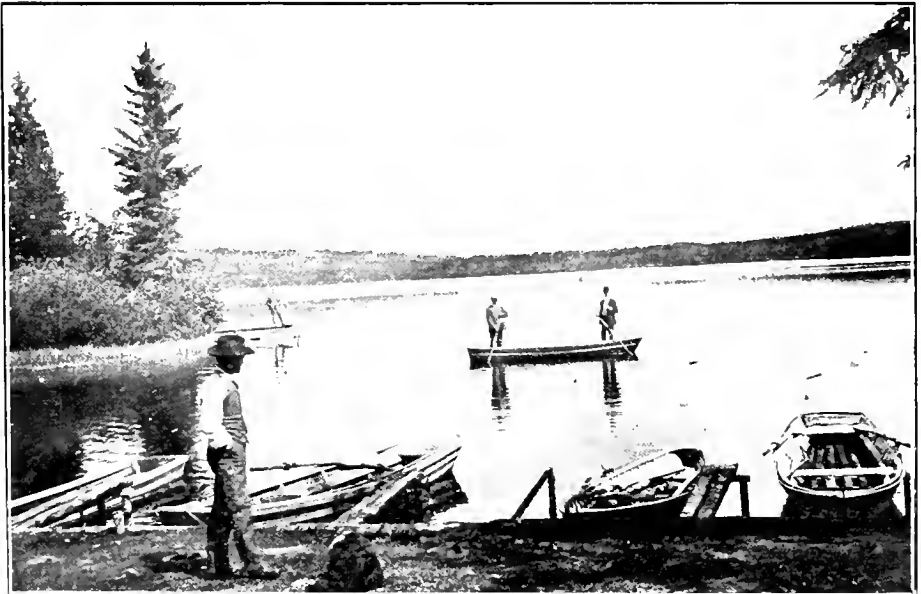


Erecting Fence around Buffalo Park.





Forest Fire in British Columbia.

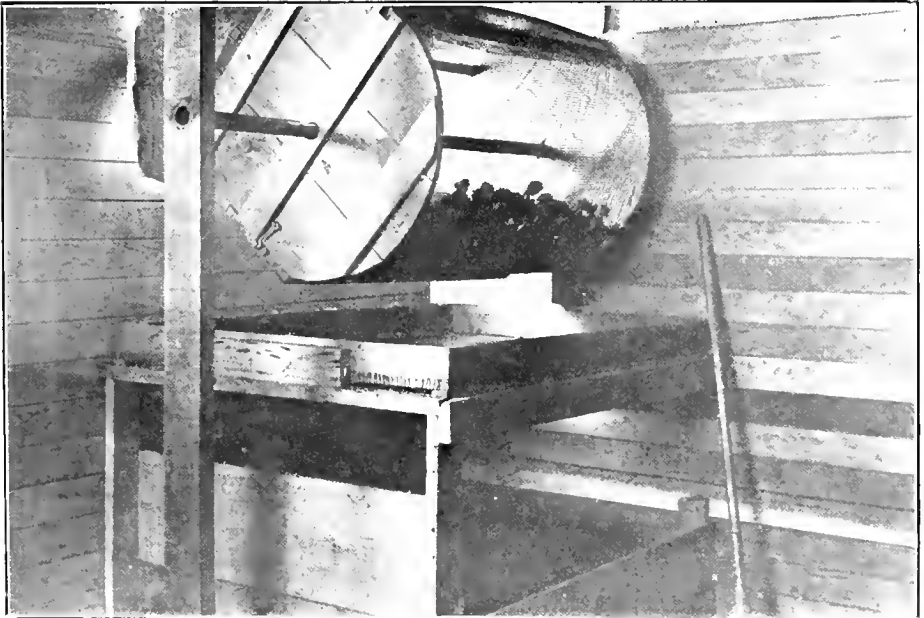


Fish Lake in Long Lake Forest Reserve.



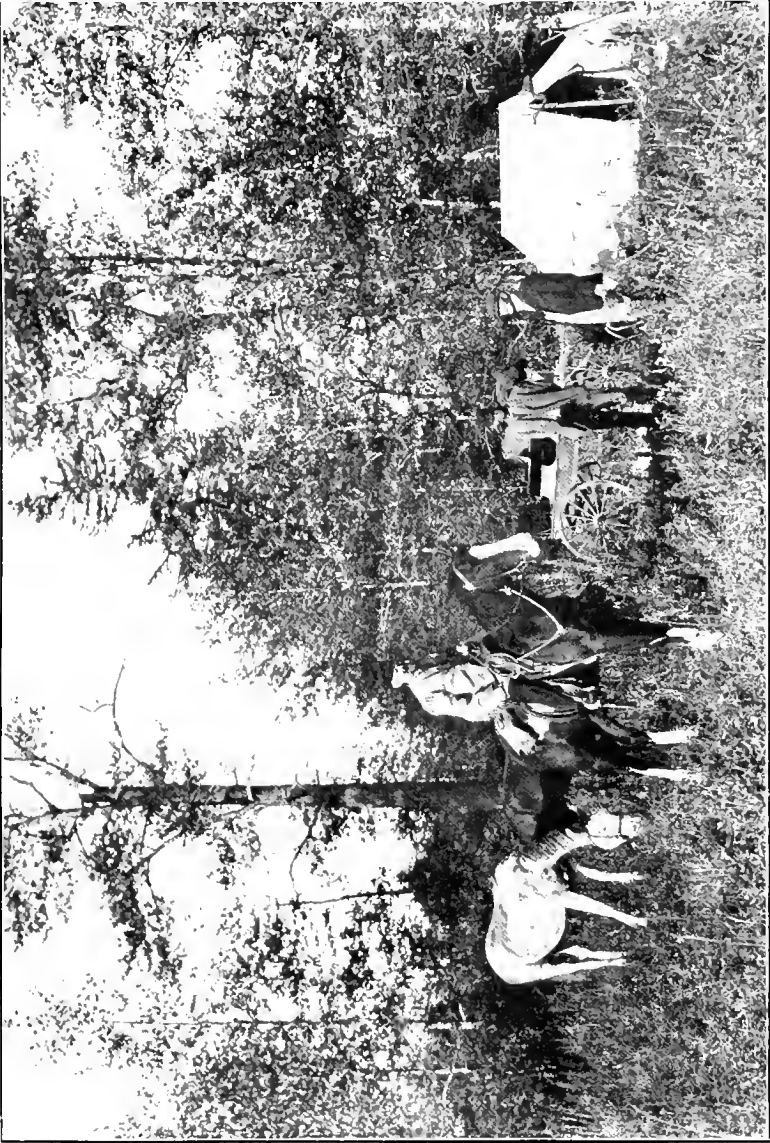


Head-gate on Irrigation Ditch, Alberta Railway and Irrigation Company's scheme.



Cylindrical Screen for shaking out seed, Seedhouse at Forest Nursery Station, Indian Head, Sask.





Forest Ranger interviewing Campers, Cypress Hills Reserve, Alberta.







Forest Survey Party, Summer 1908,  
Riding Mountain Reserve, Manitoba.



Grazing, Riding Mountain Reserve, Manitoba.

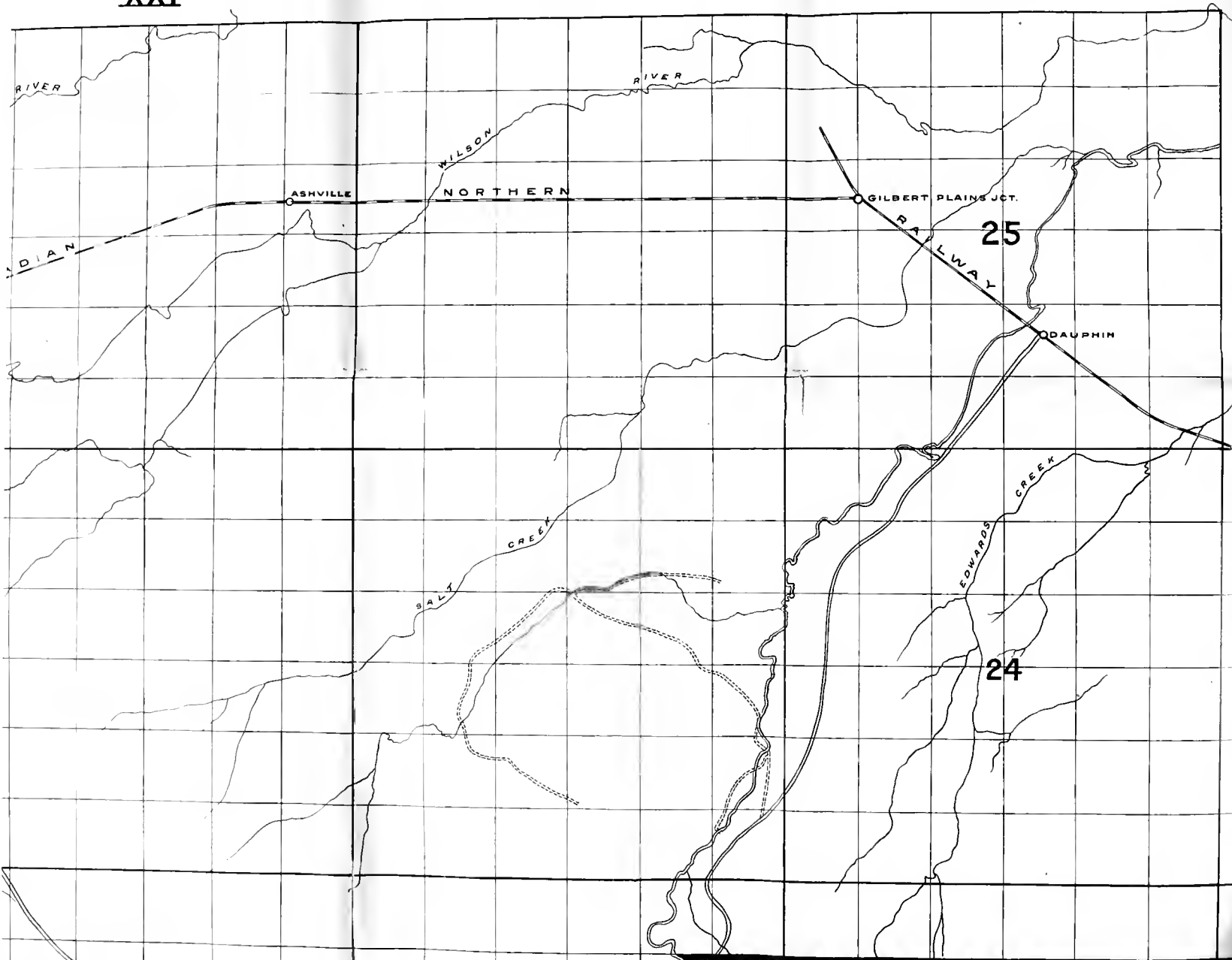




XXI

XX

XIX



XVIII

R1  
R2  
S1  
S2

R1  
R2  
S1  
S2  
L1  
L2  
X

T. B. 578

23

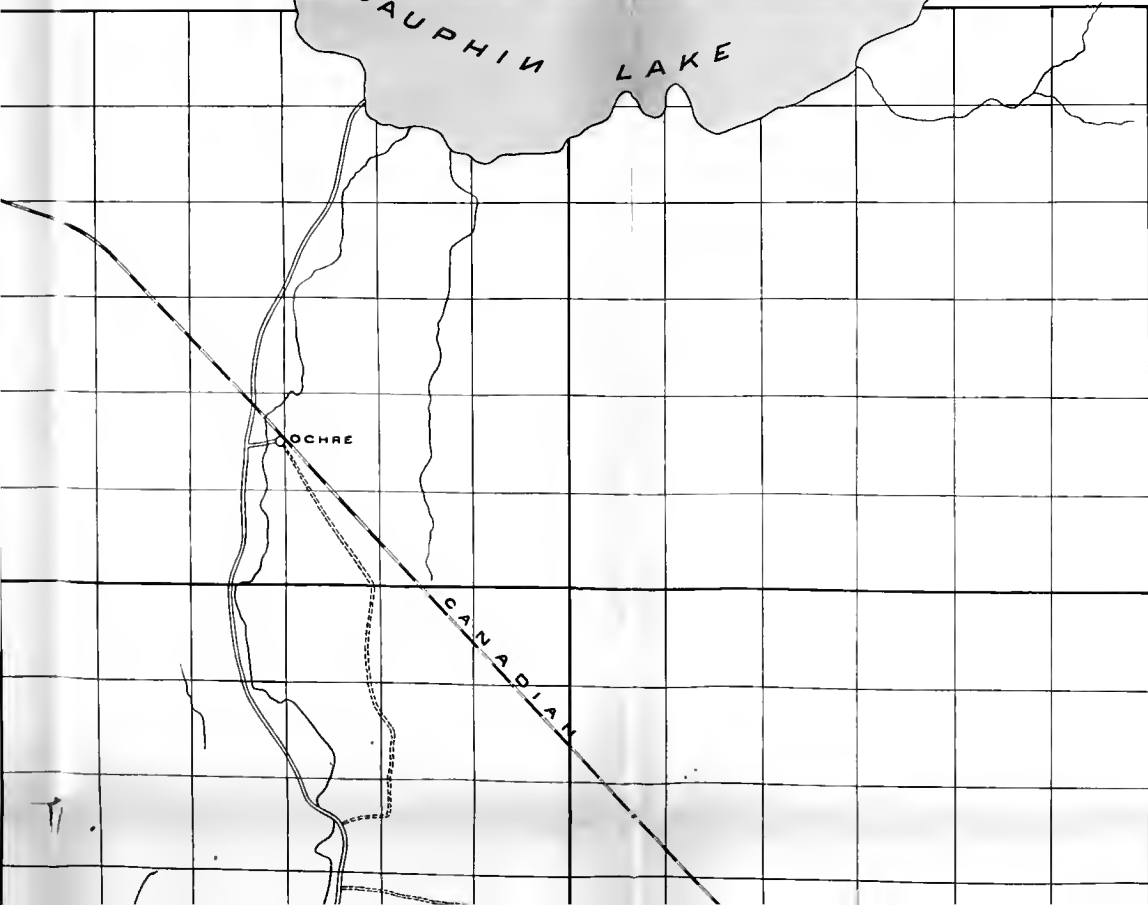
XVII

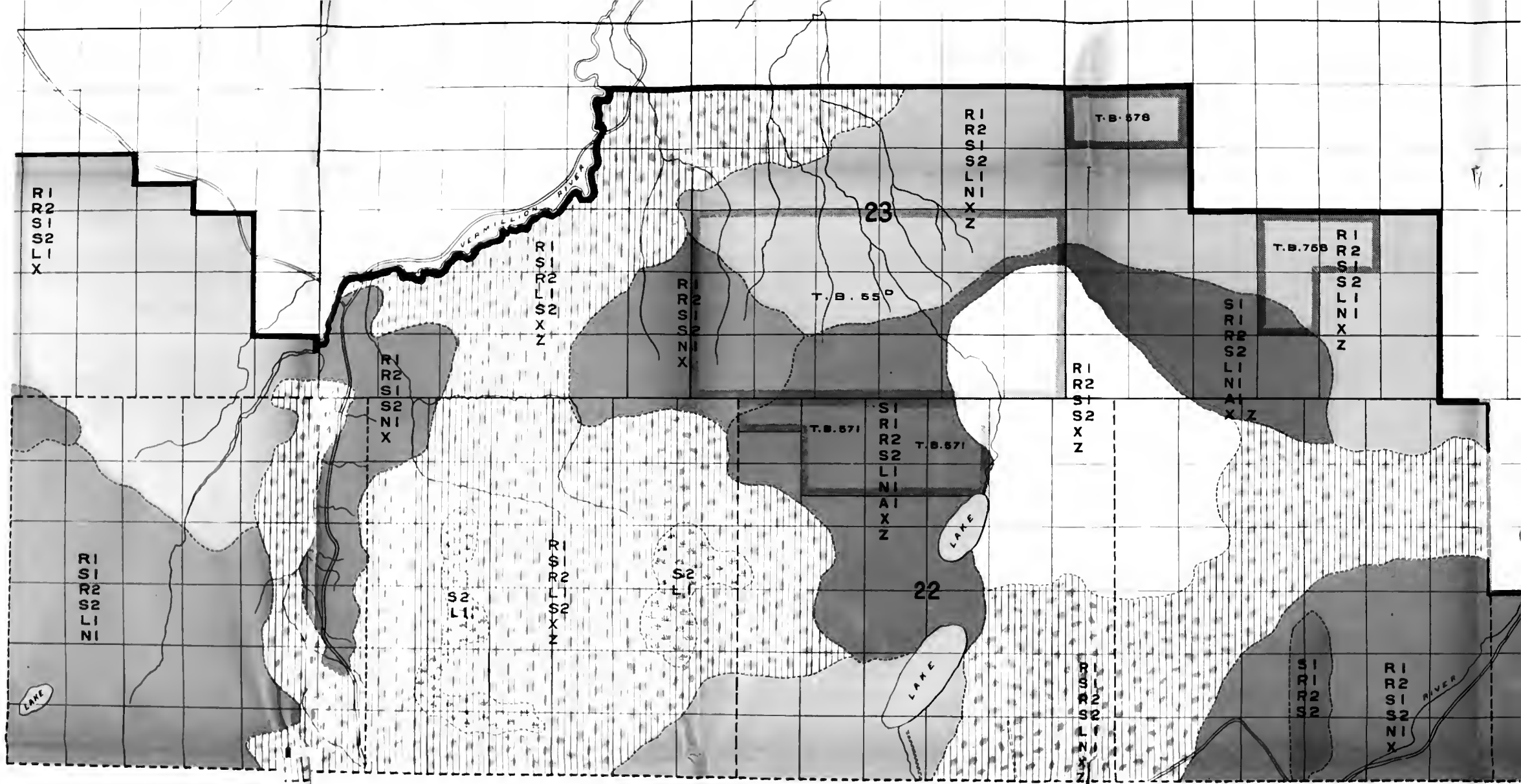
XVI

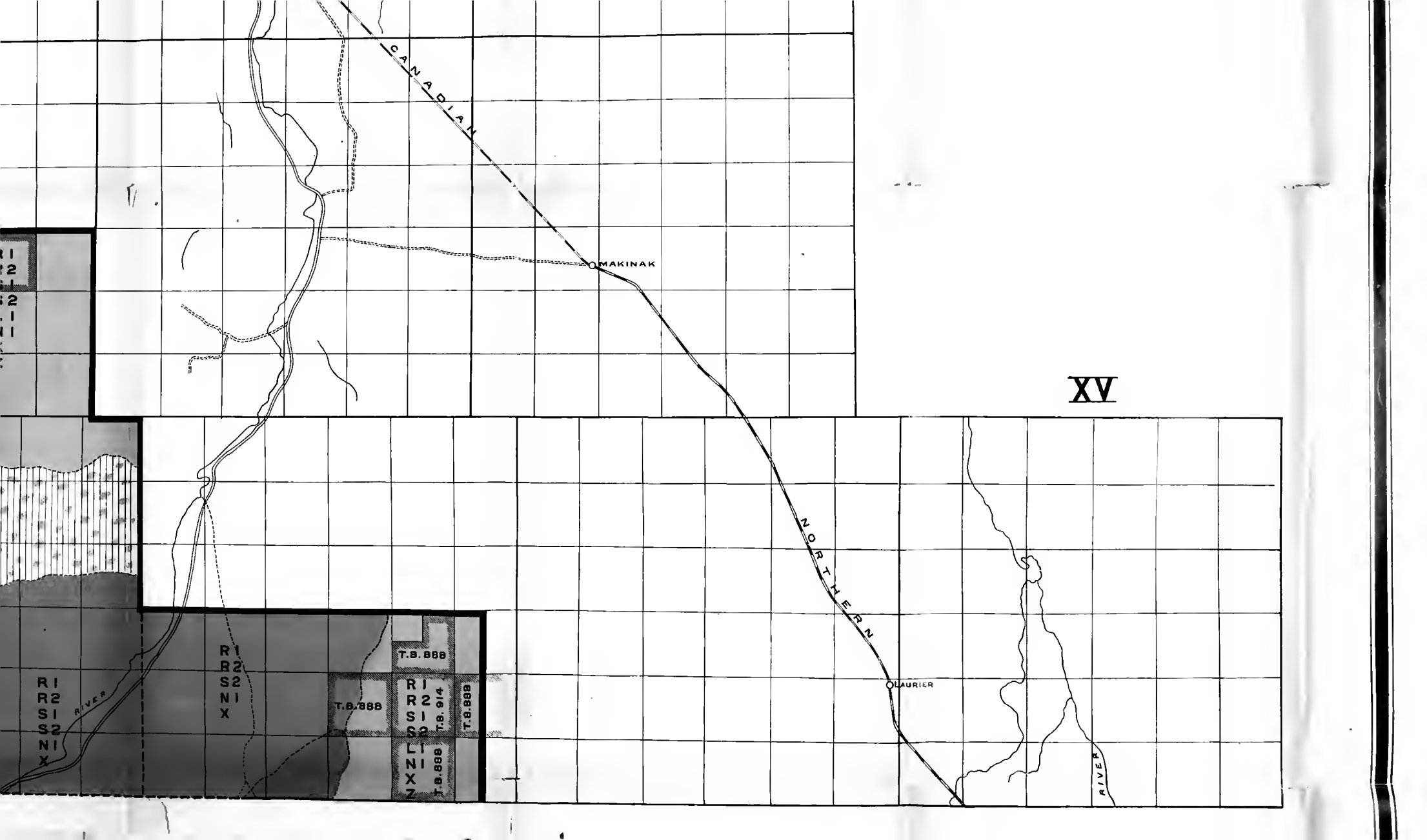
DAUPHIN LAKE

DOCHRE

CANADIAN







R1  
R2  
S1  
S2  
N1  
N2  
X



R1  
R2  
S1  
S2  
N1  
N2  
X

R1  
R2  
S1  
S2  
N1  
N2  
X

T.B.888  
R1  
R2  
S1  
S2  
N1  
N2  
X  
T.B.888  
T.B.914  
T.B.888  
T.B.888

XV

CANADIAN

MAKINAK

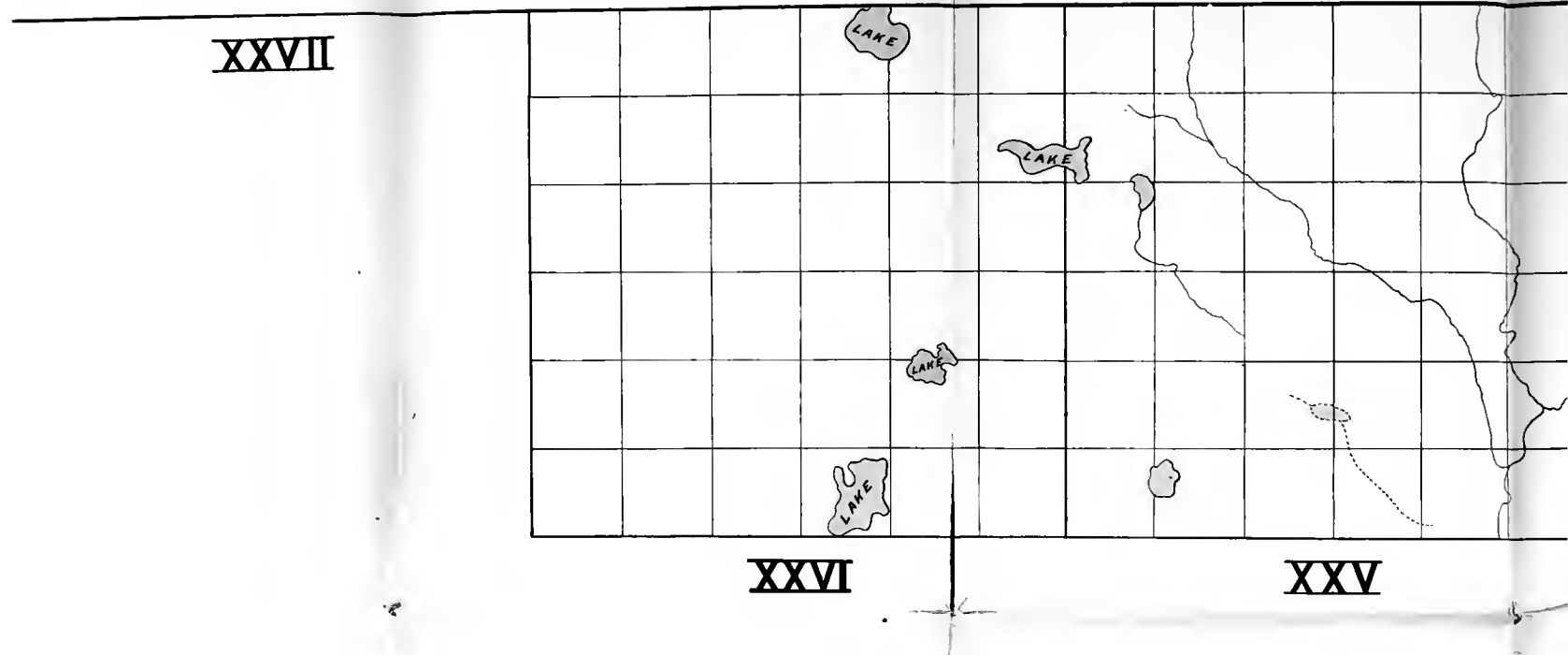
NORTHERN

LAURIER

RIVER







Department of the Interior  
Canada

HONOURABLE FRANK OLIVER, MINISTER  
W. W. CORY, DEPUTY MINISTER

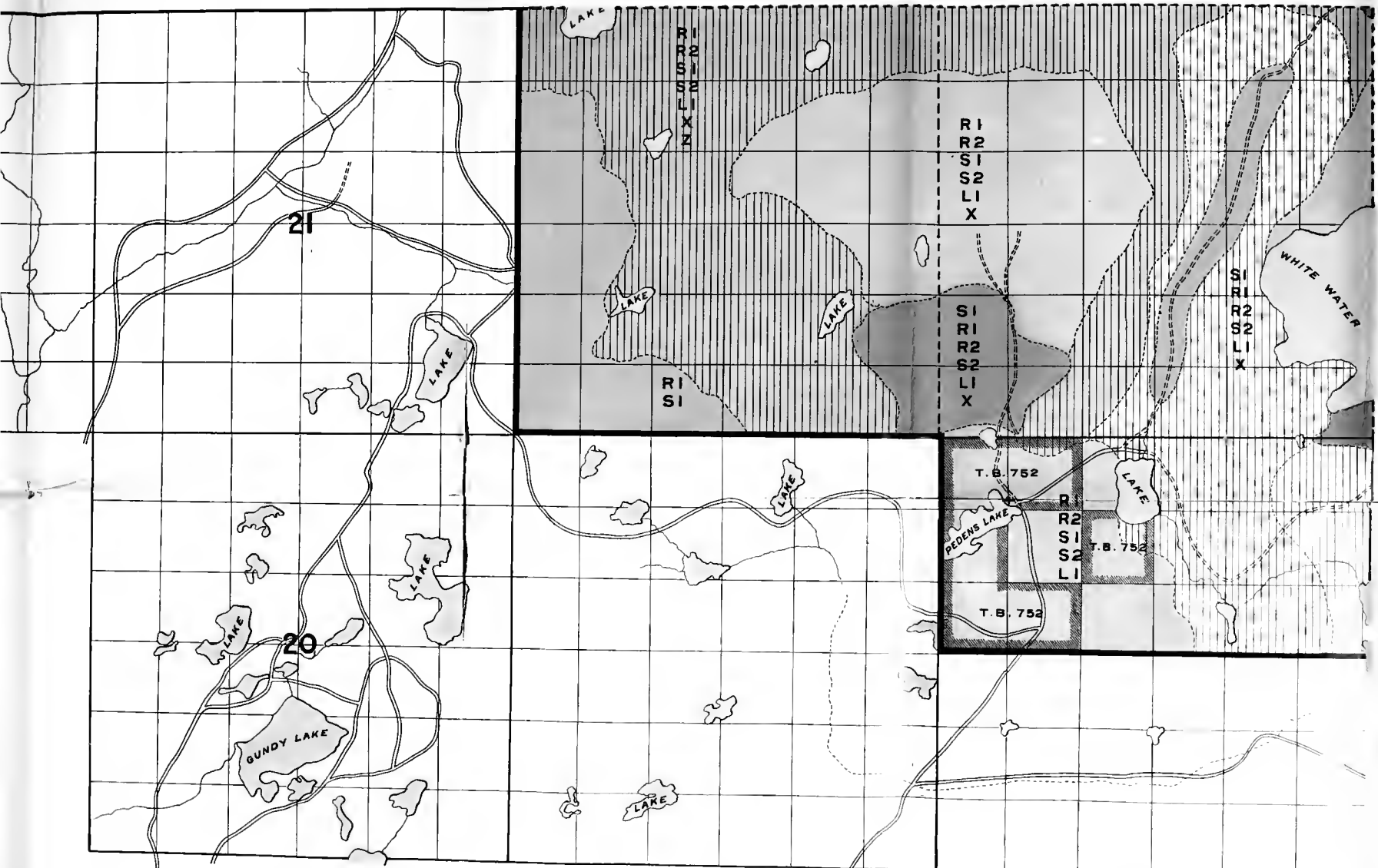
**FORESTRY BRANCH**

R. H. CAMPBELL, SUPERINTENDENT

**RIDING MOUNTAIN FOREST RESERVE**

PROVINCE OF MANITOBA

SCALE: ONE MILE TO AN INCH



XXIV

XXIII

XXII

# Department of the Interior Canada

HONOURABLE FRANK OLIVER, MINISTER  
W. W. CORY, DEPUTY MINISTER

## FORESTRY BRANCH

R. H. CAMPBELL, SUPERINTENDENT

# RIDING MOUNTAIN FOREST RESERVE

PROVINCE OF MANITOBA










SCALE: ONE MILE TO AN INCH

1909

SURVEYED BY J. R. DICKSON, B.S.F.

COMPILED BY GEO. S. PROCTOR


























### LEGEND

|   |                                 |
|---|---------------------------------|
|    | LESS THAN 2000 B.F. PER ACRE    |
|    | 2,000 TO 5,000 B.F. PER ACRE    |
|    | WOODLAND, CORDWOOD, POLES, ETC. |
|    | SCATTERED MERCHANTABLE TIMBER   |
|   | BURN FOREST COVER ESTABLISHED   |
|  | BURN SCATTERED TREES            |
|  | BURN NOT RESTOCKING             |
|  | GRASSLAND, PARKS, ETC.          |
|  | TIMBER BERTHS                   |

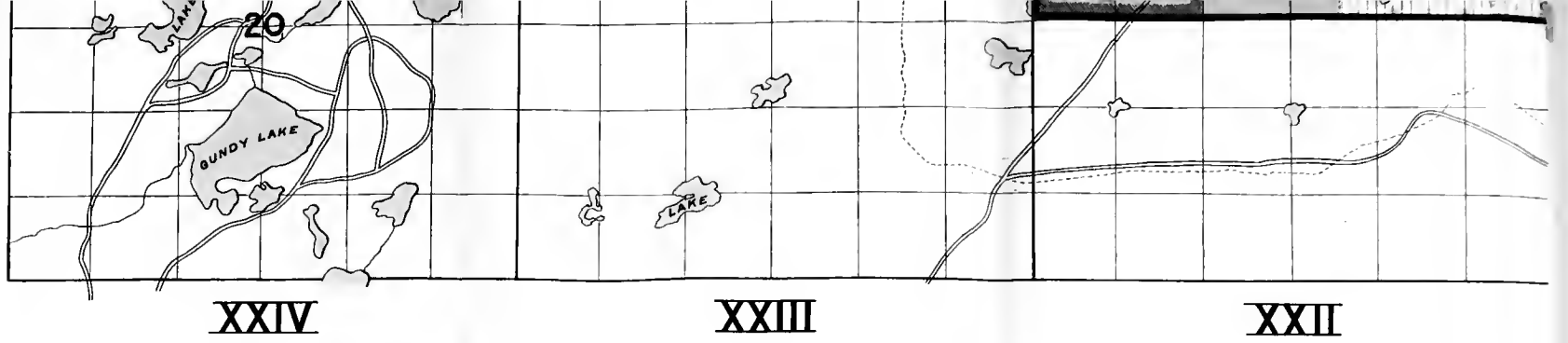
### SYMBOLS OF TREE SPECIES

|                                 |               |
|---------------------------------|---------------|
| R.1. POPULUS TREMULOIDES        | ASPEN POPLAR  |
| R.2. POPULUS BALSAMIFERA        | BALSAM POPLAR |
| S.1. PICEA CANADENSIS           | WHITE SPRUCE  |
| S.2. PICEA MARIANA              | BLACK SPRUCE  |
| N.1. BETULA ALBA VAR PAPYRIFERA | CANOE BIRCH   |
| L.1. LARIX AMERICANA            | TAMARACK      |
| P.1. PINUS BANKSIANA            | JACKPINE      |
| X. SALIX                        | WILLOW        |
| Z. ALNUS                        | ALDER         |

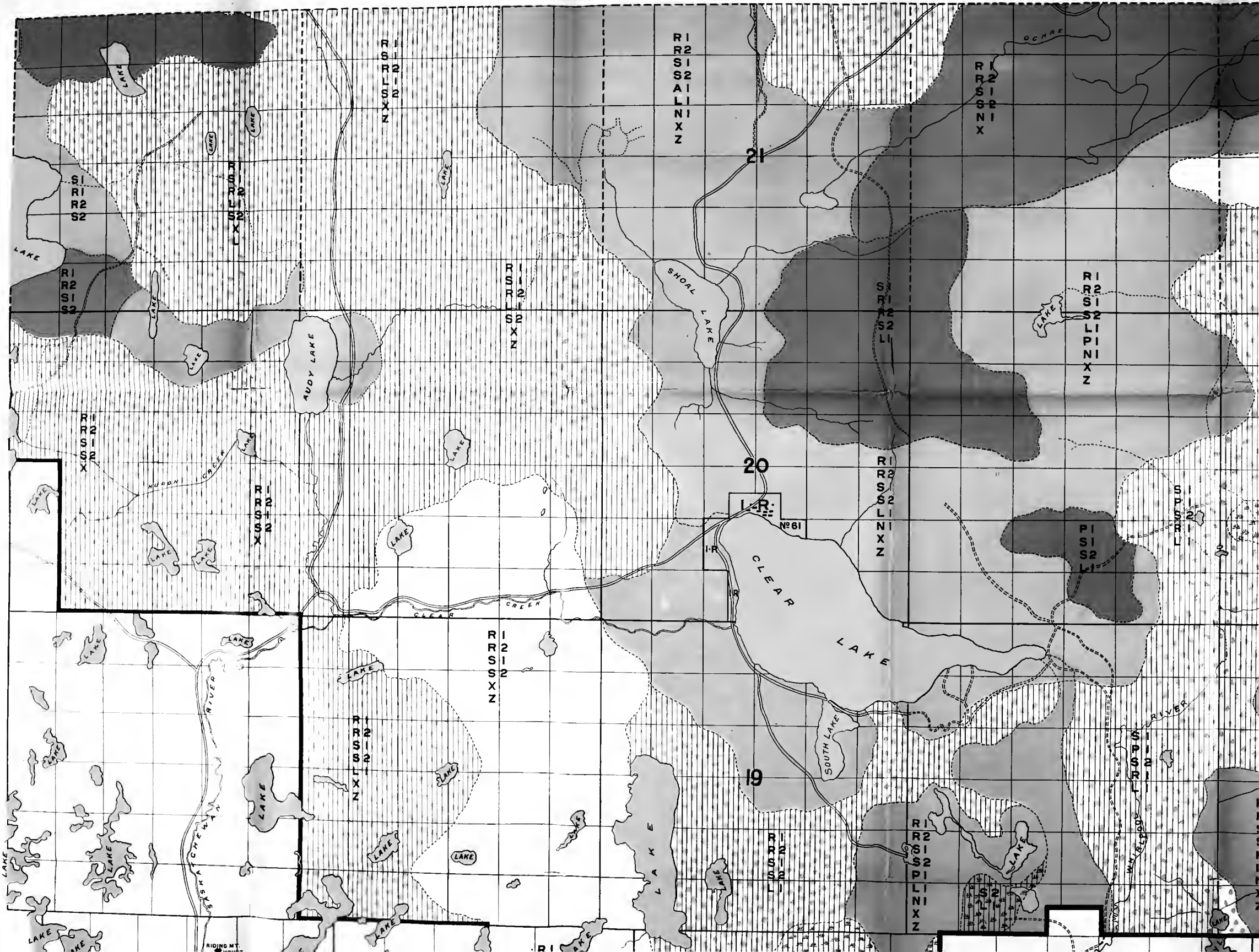
### CONVENTIONAL SIGNS

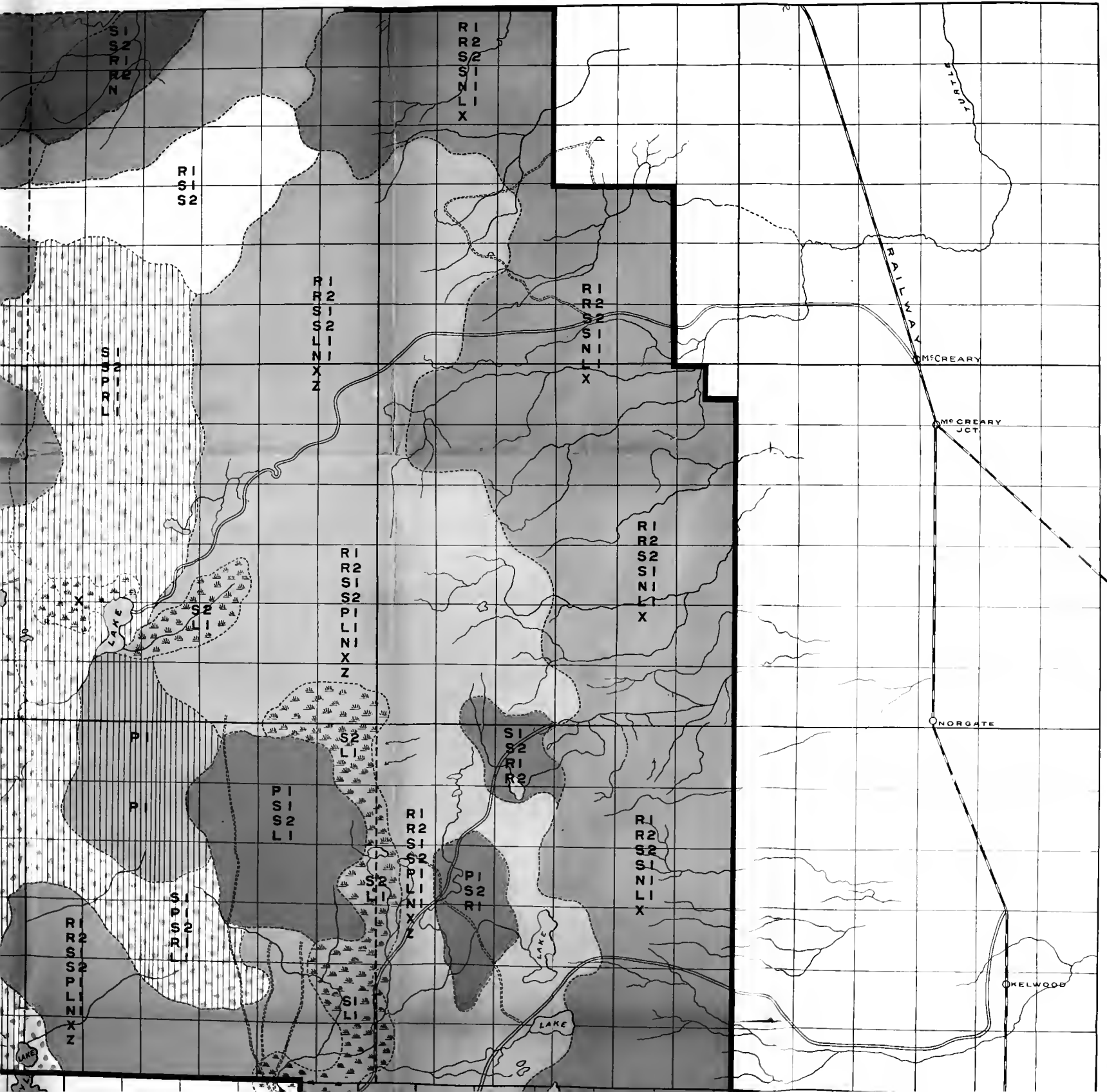
|   |                           |   |                                   |
|---|---------------------------|---|-----------------------------------|
|  | Fence                     |  | Hotel                             |
|  | Bridge                    |  | Store                             |
|  | Ferry                     |  | School                            |
|  | Ford                      |  | Church                            |
|  | Nursery                   |  | Telegraph office                  |
|  | Corral                    |  | Cabin                             |
|  | Supervisor's headquarters |  | Logging camp                      |
|  | Ranger's headquarters     |  | Sawmill, portable                 |
|  | House                     |  | Sawmill, stationary               |
|  | Railroad station          |  | Grist mill                        |
|   |                           |  | Grist and sawmill                 |
|   |                           |  | Boundary line for classifications |
|   |                           |  | Railroad                          |
|   |                           |  | Wagon road                        |
|   |                           |  | Secondary or private road         |

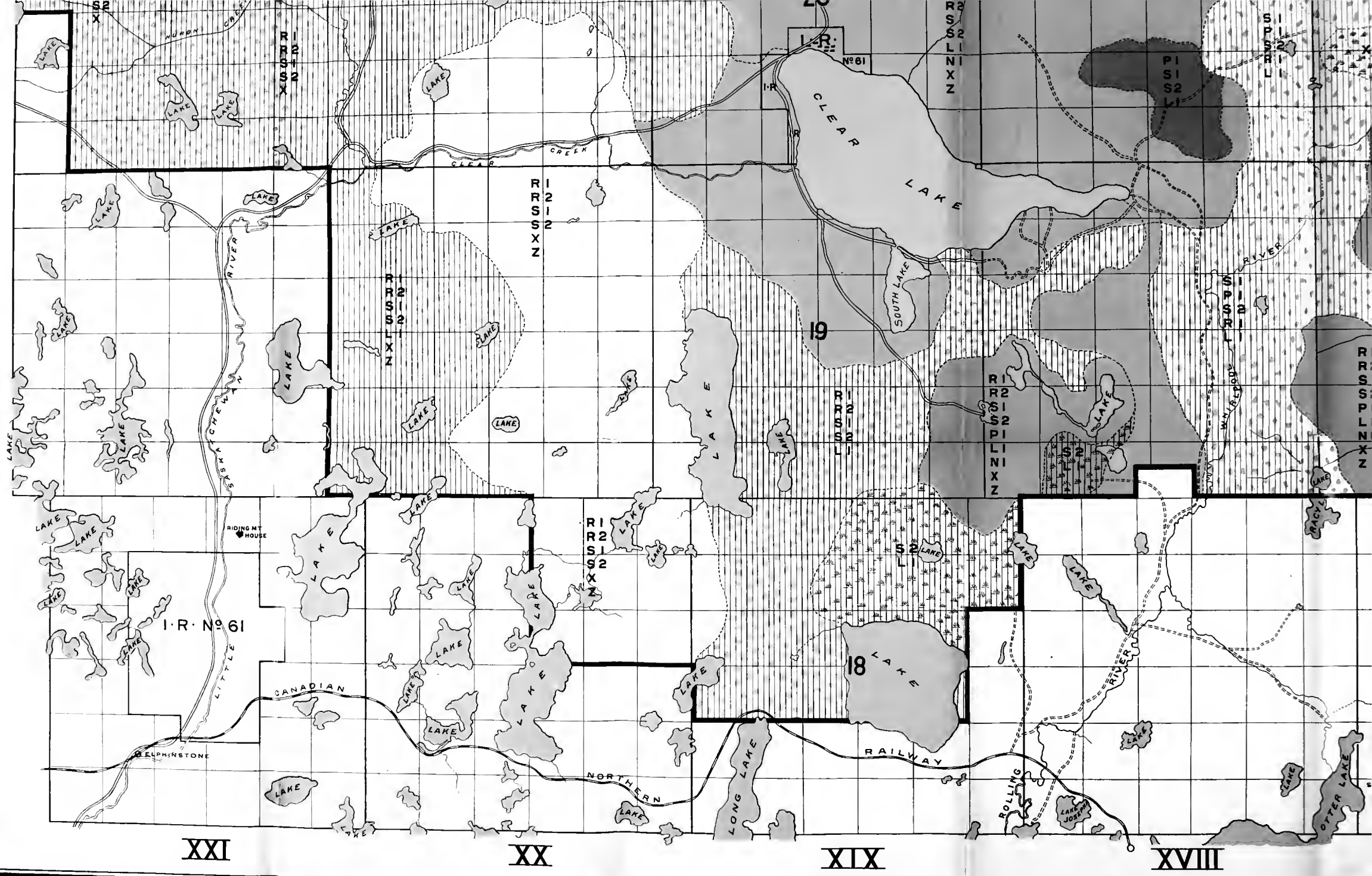
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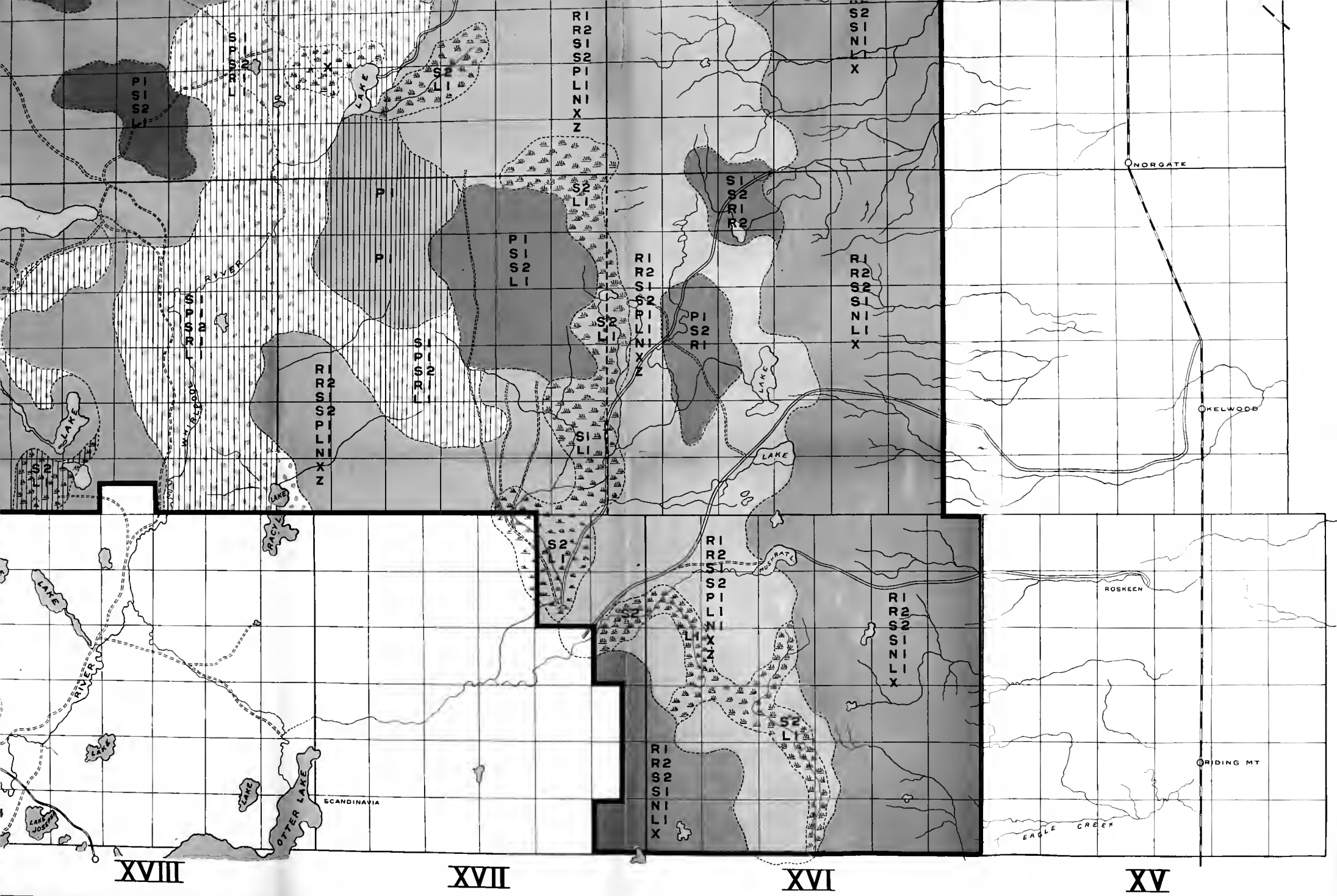












XVIII

XVII

XVI

XV





XXVII

XXVI

XXV

CANADIAN SHORT CREEK NORTHERN CREEK

SHORTDALE

STREVAL

MEHARRY

R1  
R2  
X

R1  
R2

R1  
R2

R1  
R2  
X

R1  
R2  
S2  
L

LAKE

LAKE

R1  
R2  
X

S1  
S2  
R1  
R2  
X

S1  
S2  
R1  
L1  
X

T. B. 571A

S1  
S2  
R1  
R2  
X

R1  
R2  
S1  
S2  
L  
X

PLEASANT VALLEY CREEK

LAKE

LAKE

R1  
R2  
X

R1  
R2  
X

R1  
R2  
X

NORTHERN

OMENARRY

XXIV

XXIII

XXII

XXV

B. 371A

S1  
S2  
R1  
R2  
X

R1  
R2  
S1  
S2  
L  
X

RAILWAY

25

GRAND VIEW

GILBERT PLAINS

CAMP

VALLEY

RIVER

WILSON

VALLEY

24

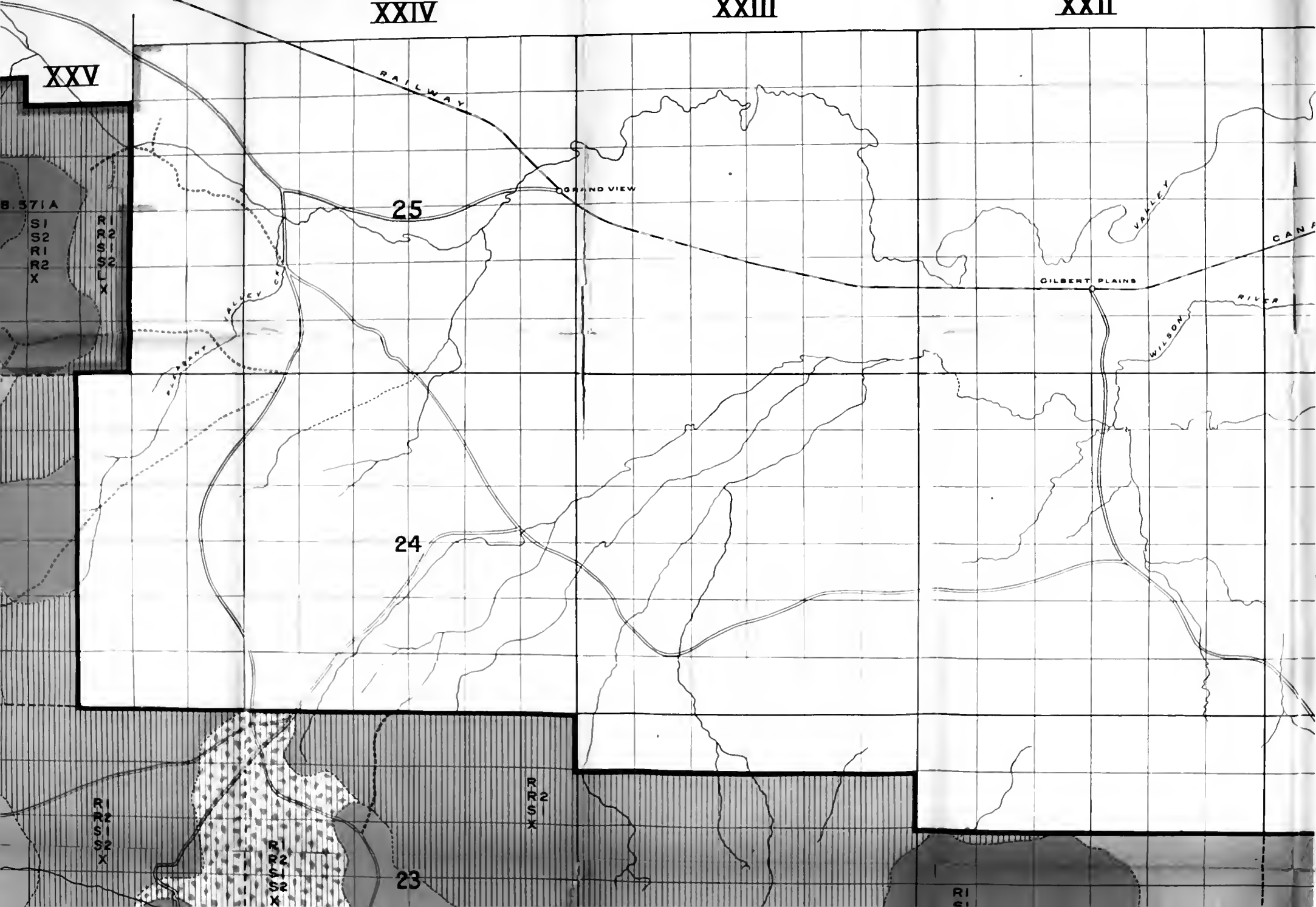
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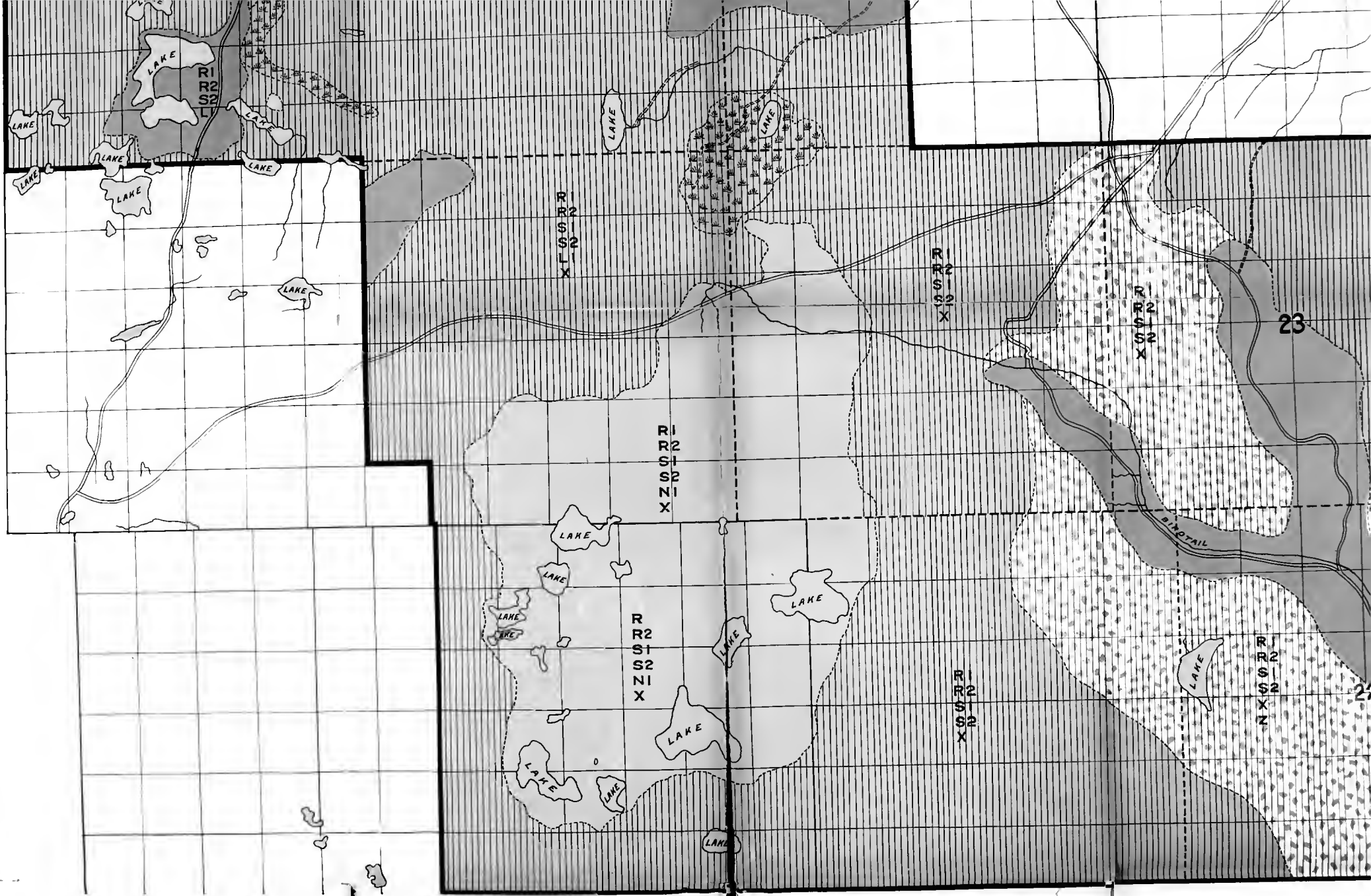
R1  
R2  
S1  
S2  
L  
X

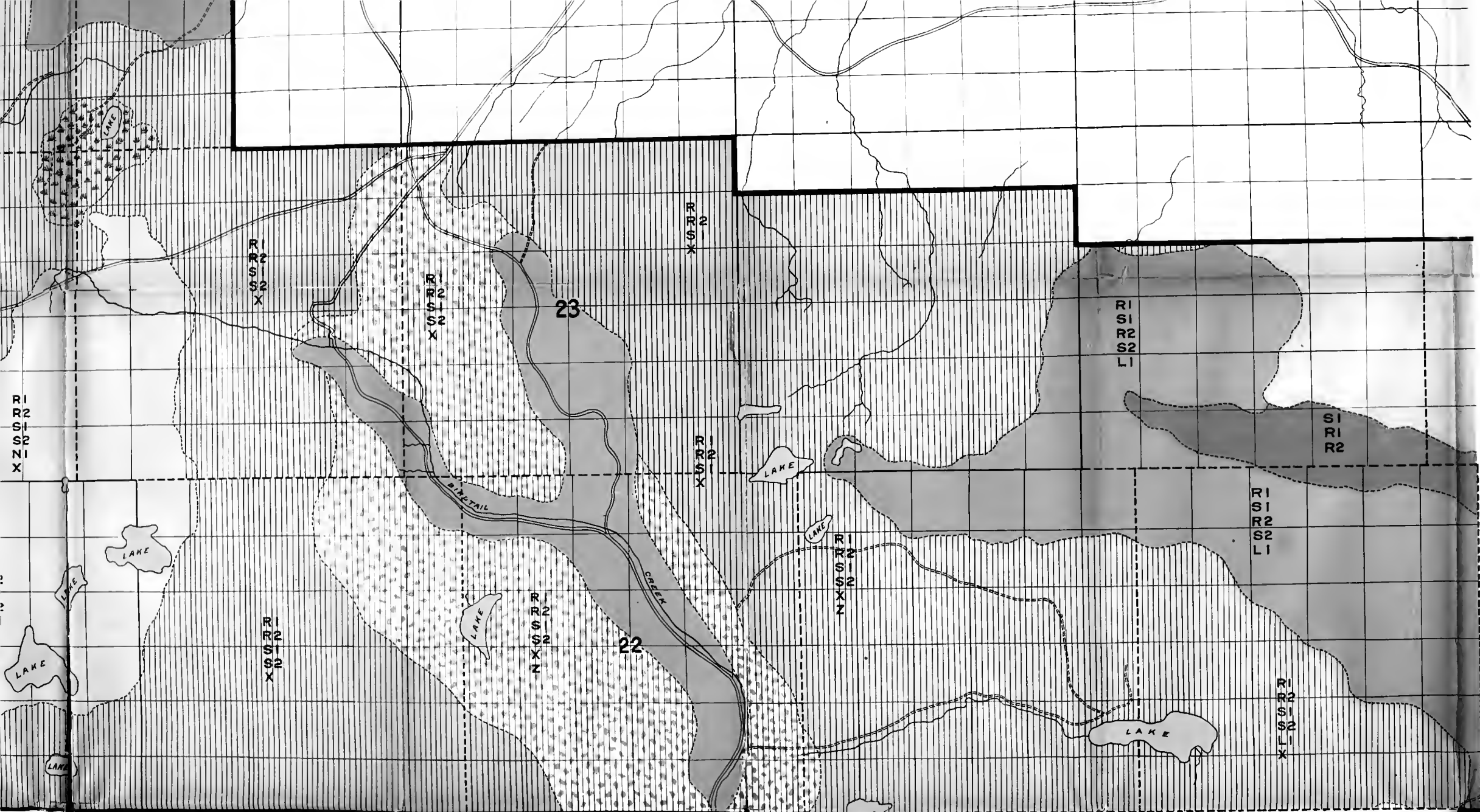
R1  
R2  
S1  
S2  
L  
X

R1  
R2  
S1  
S2  
L  
X

R1











Department of the Interior  
Canada

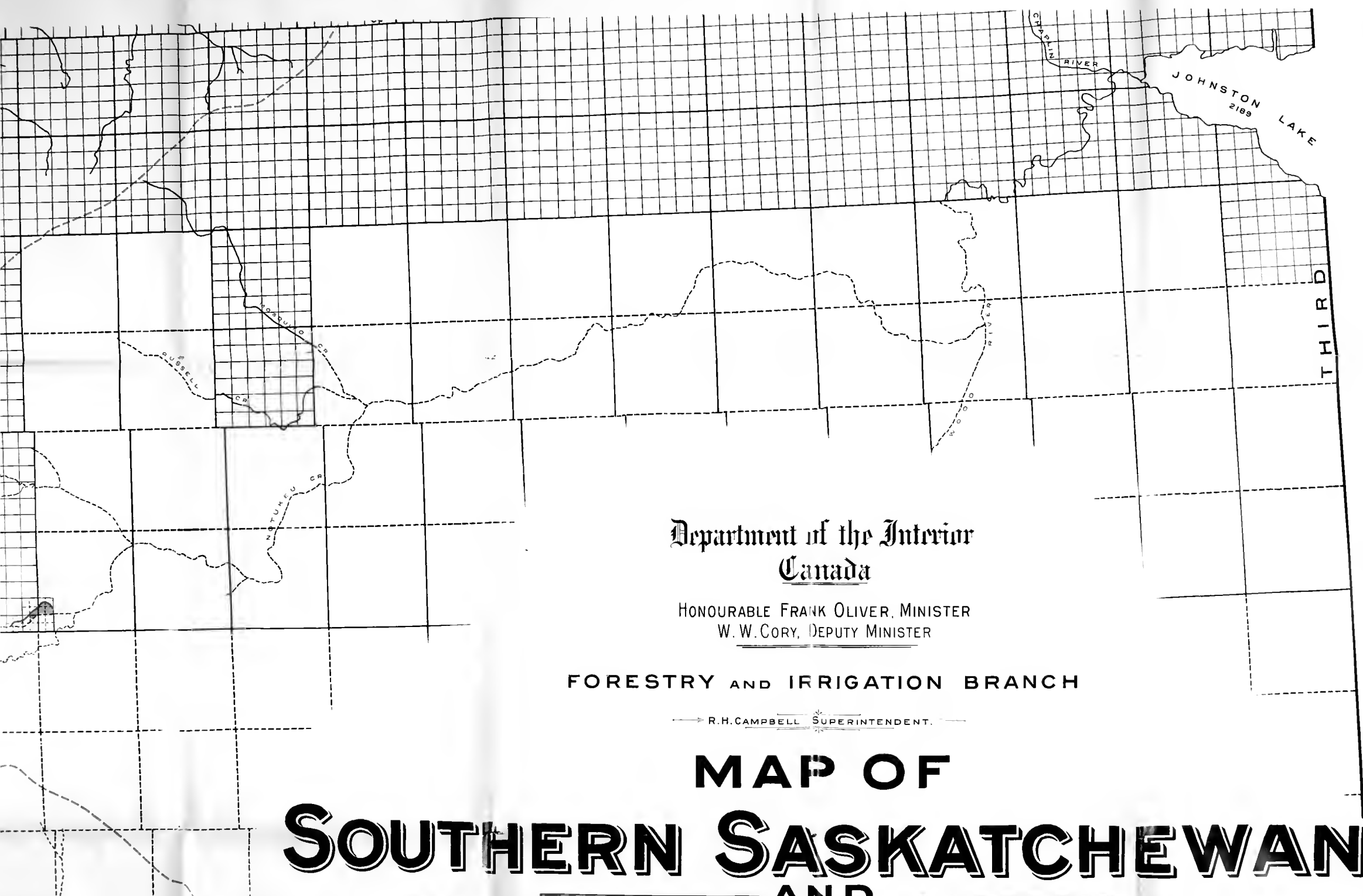
HONOURABLE FRANK OLIVER, M.P.  
W. W. CORY, DEPUTY MINISTER

FORESTRY AND IRRIGATION

→ R. H. CAMPBELL, SUPERINTENDENT

# MAP OF SOUTHERN SASKATCHEWAN AND





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FORESTRY AND IRRIGATION BRANCH

— R. H. CAMPBELL SUPERINTENDENT. —

MAP OF  
**SOUTHERN SASKATCHEWAN**  
AND

# MAP OF SOUTHERN SASKATCHEWAN AND SOUTHERN ALBERTA

SHOWING IRRIGATION CANALS, INDUSTRIAL AND  
AND  
LANDS UNDER IRRIGATION

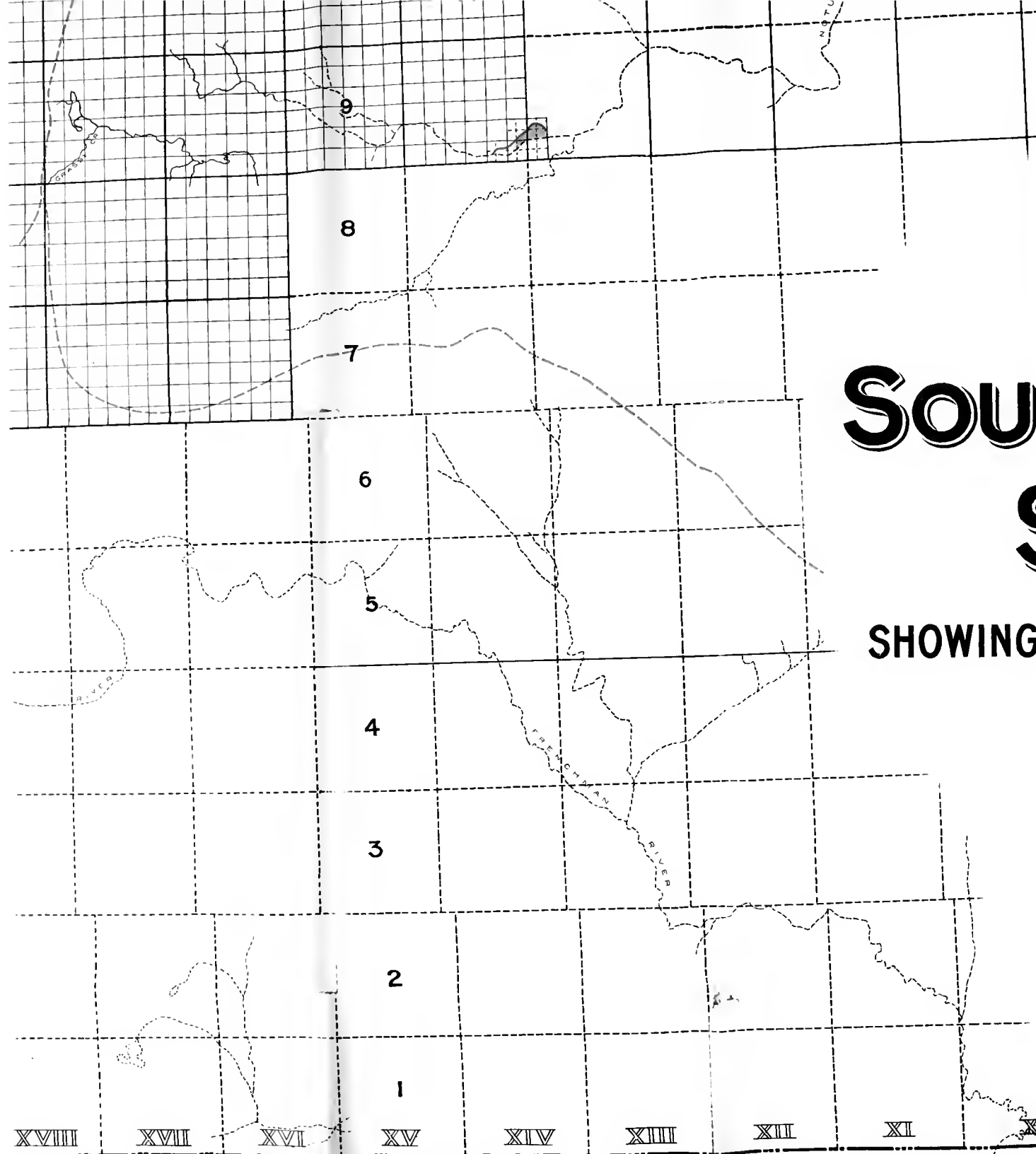
SCALE 3 MILES TO AN INCH

CORRECTED TO MARCH 31<sup>ST</sup> 1909

COMPILED BY

LEGEND

- CONSTRUCTED IRRIGATION CANALS
- PROPOSED IRRIGATION CANALS
- LANDS IRRIGATED
- INDUSTRIAL AND DOMESTIC SCHEMES
- RAILWAYS
- BOUNDARIES OF WATERSHEDS
- ELEVATIONS 1231



Department of the Interior  
Canada

HONOURABLE FRANK OLIVER, MINISTER  
W. W. CORY, DEPUTY MINISTER

FORESTRY AND IRRIGATION BRANCH

R. H. CAMPBELL SUPERINTENDENT.

MAP OF  
SOUTHERN SASKATCHEWAN  
AND  
SOUTHERN ALBERTA

SHOWING IRRIGATION CANALS, INDUSTRIAL AND DOMESTIC SCHEMES  
AND  
LANDS UNDER IRRIGATION.

SCALE 3 MILES TO AN INCH

CORRECTED TO MARCH 31<sup>ST</sup> 1909

COMPILED BY GEORGE S. PROCTOR.

LEGEND

CONSTRUCTED IRRIGATION CANALS .....  
PROPOSED IRRIGATION CANALS .....  
LANDS IRRIGATED .....  
INDUSTRIAL AND DOMESTIC SCHEMES .....  
RAILWAYS .....  
BOUNDARIES OF WATERSHEDS .....  
ELEVATIONS ..... 1231

XIII

XII

XI

X

IX

VIII

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V

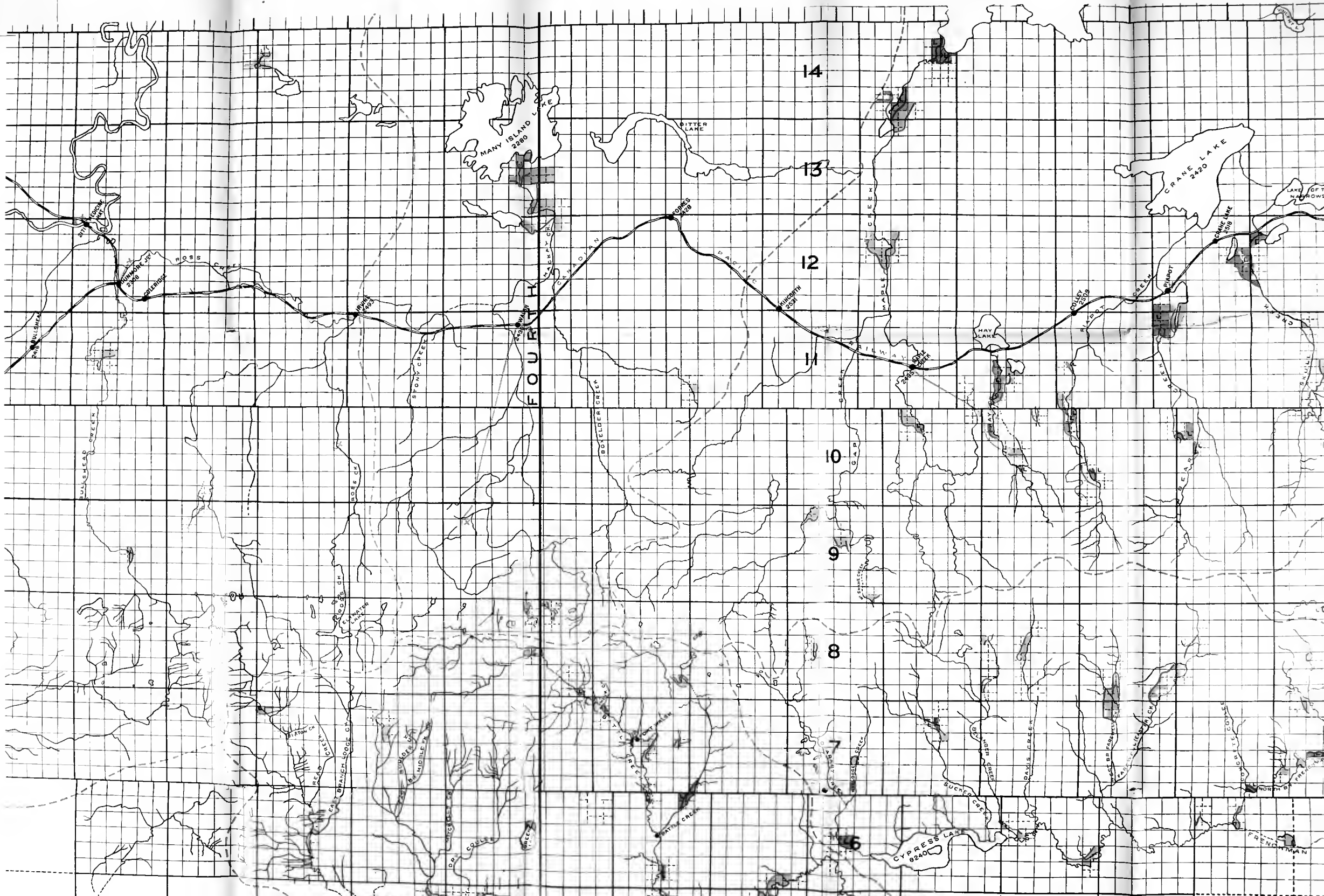
IV

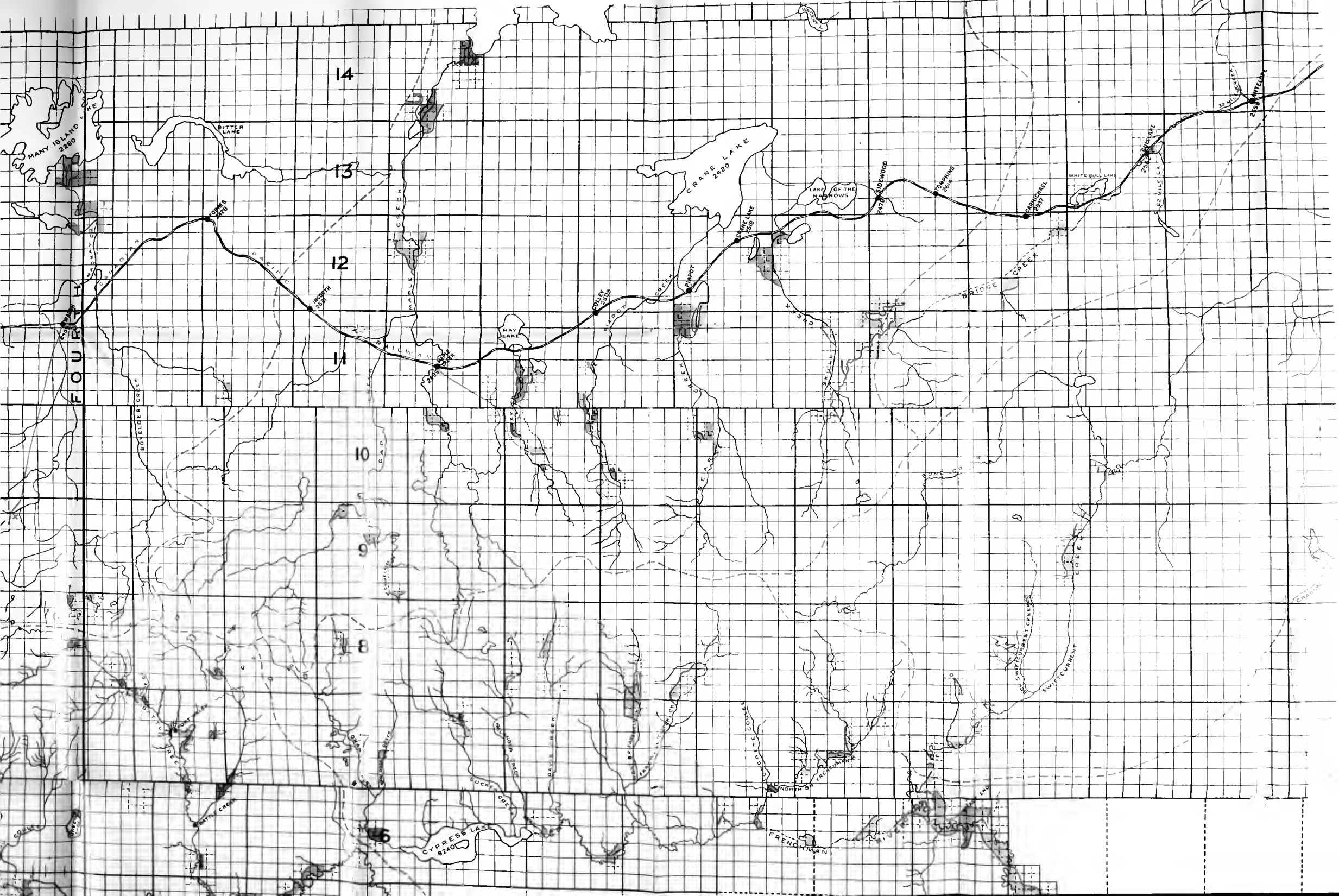
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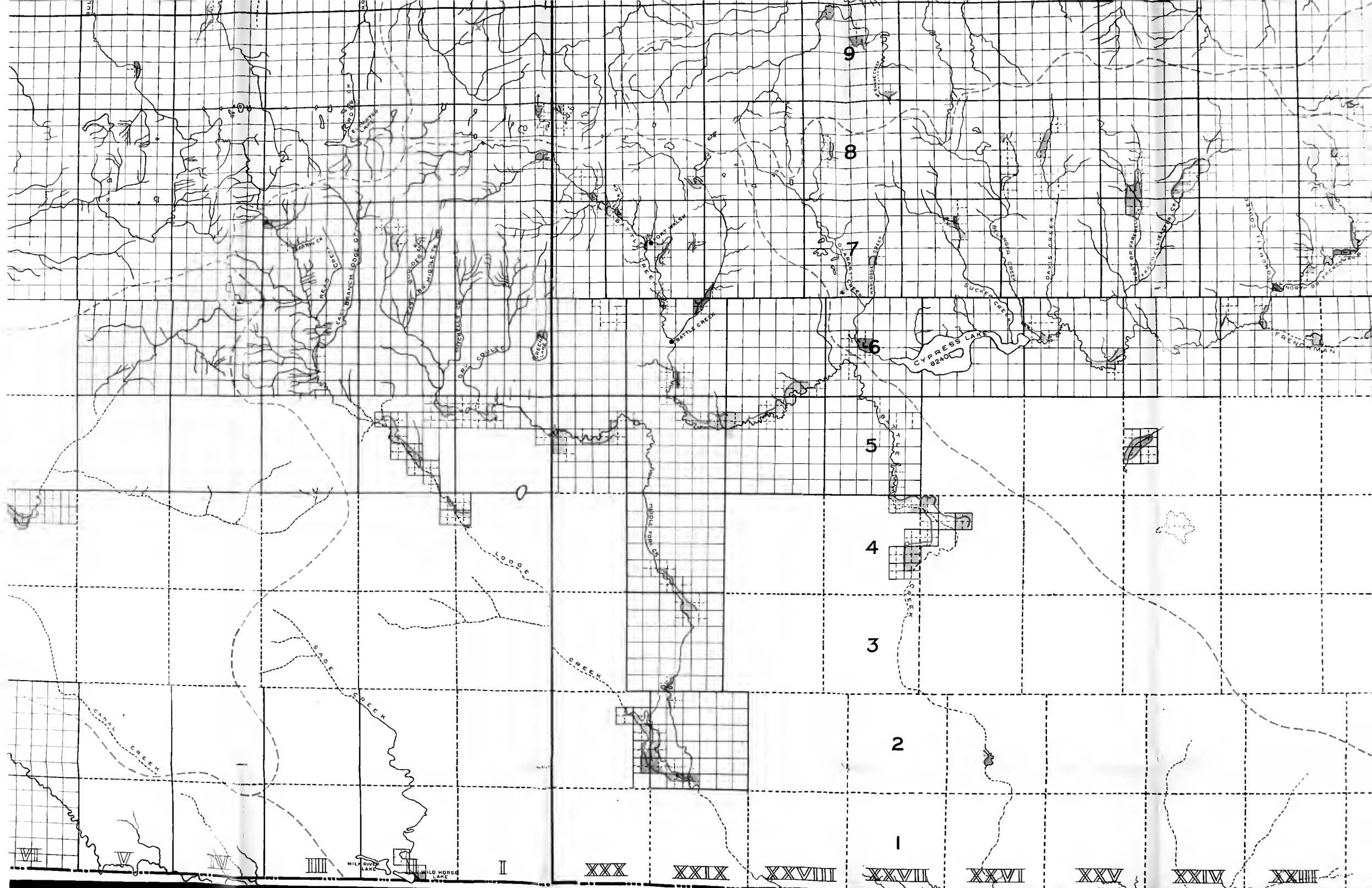
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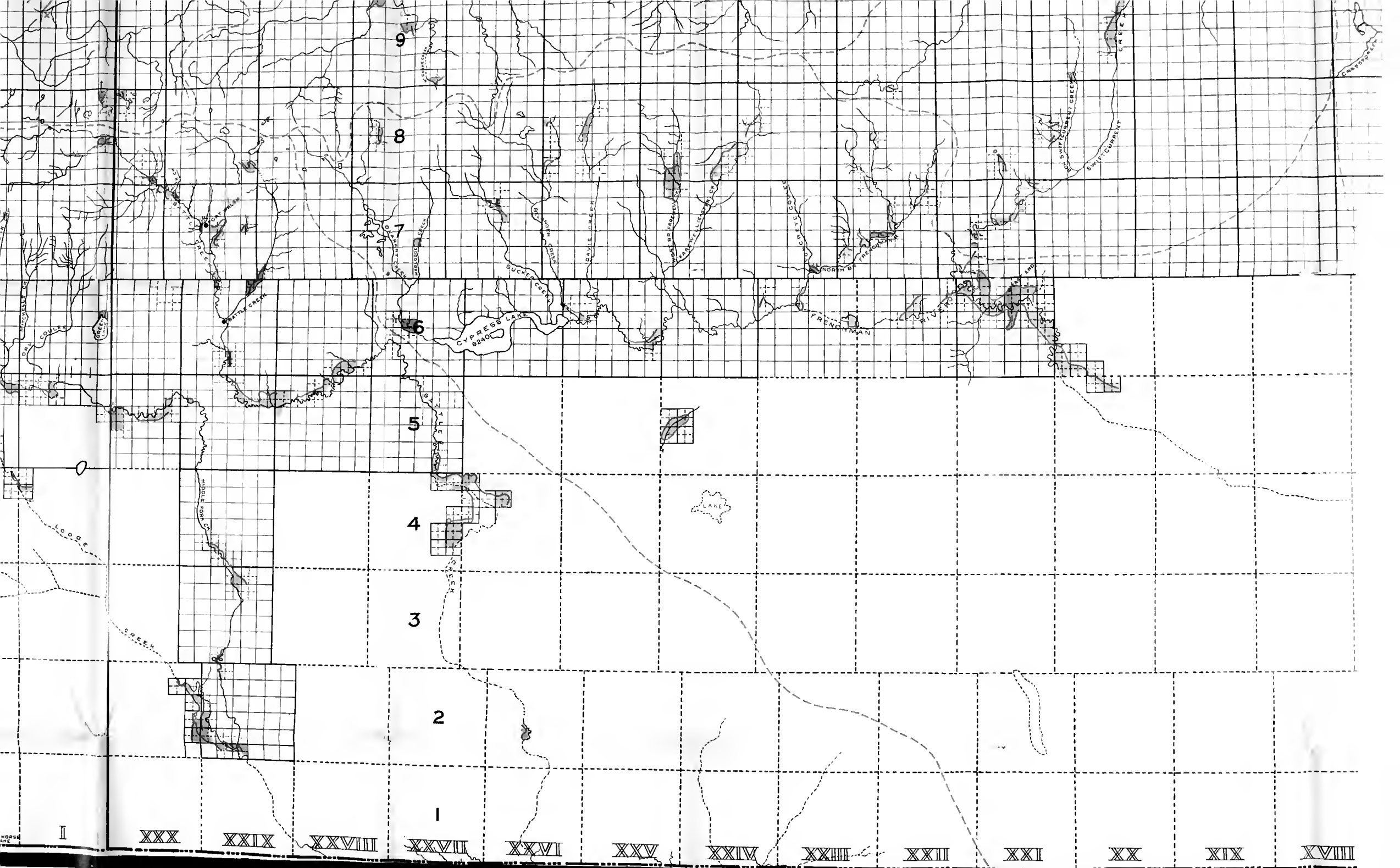
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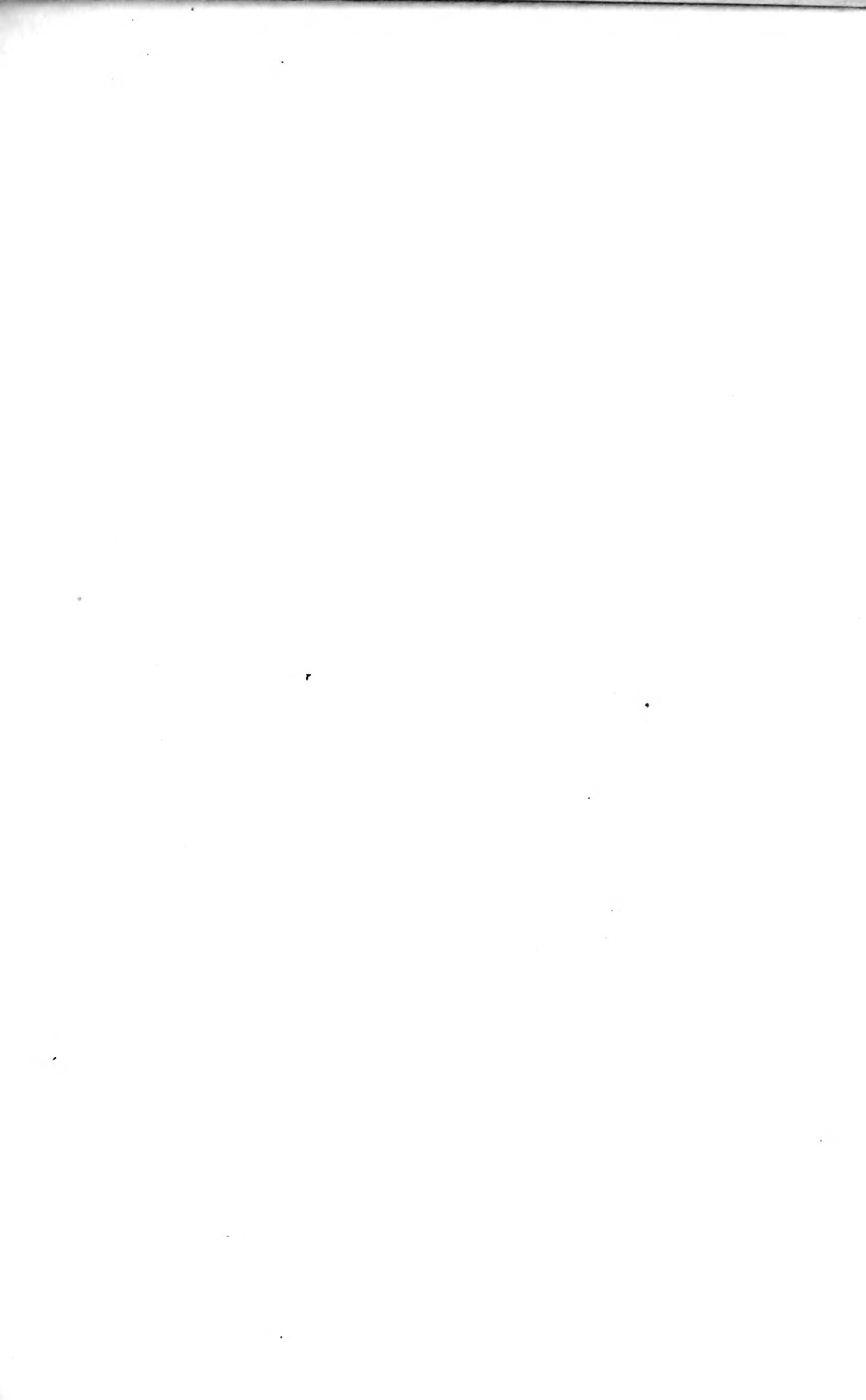
1

CYPRESS LAKE  
92400

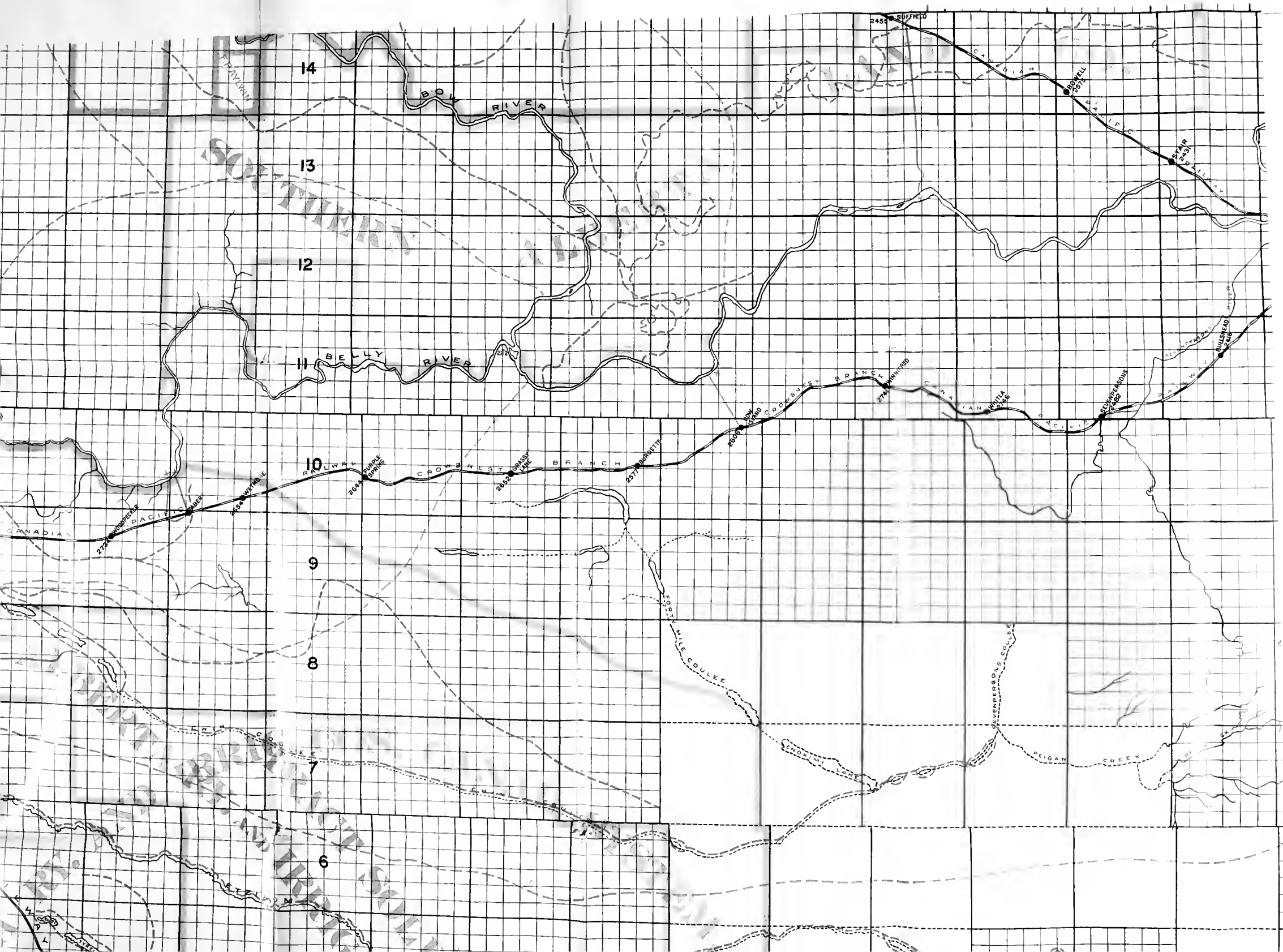
LAKE

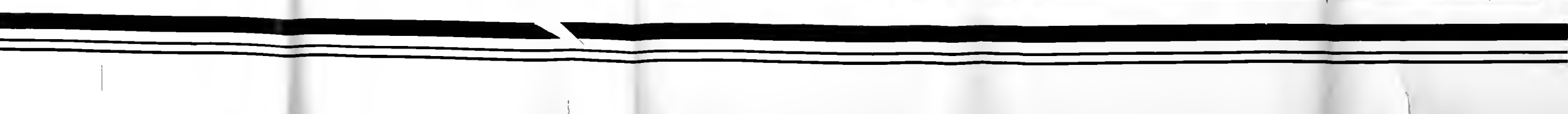
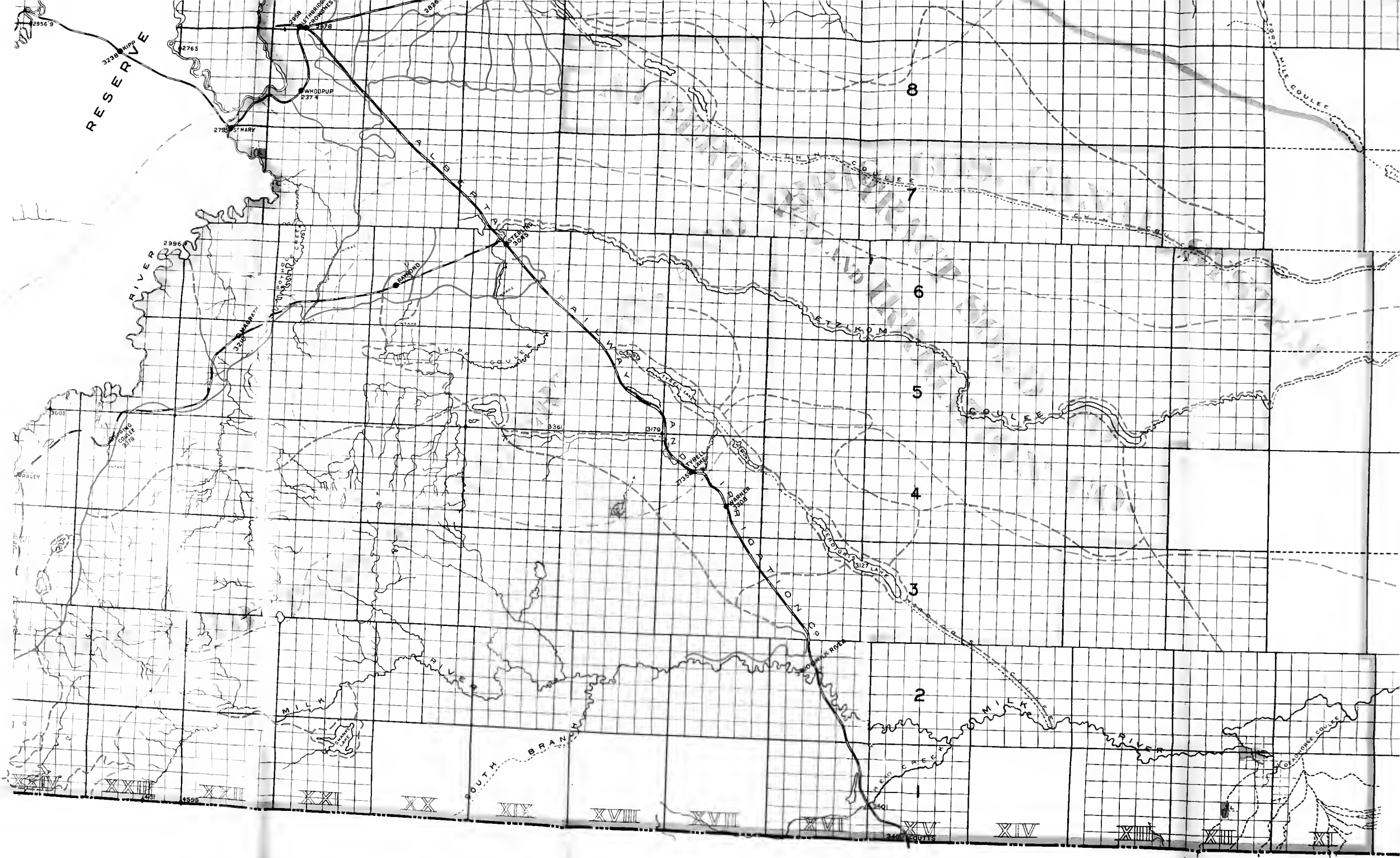
XXX XXXIX XXVIII XXVII XXVI XXV XXIV XXIII XXII XXI XX XIX XVIII

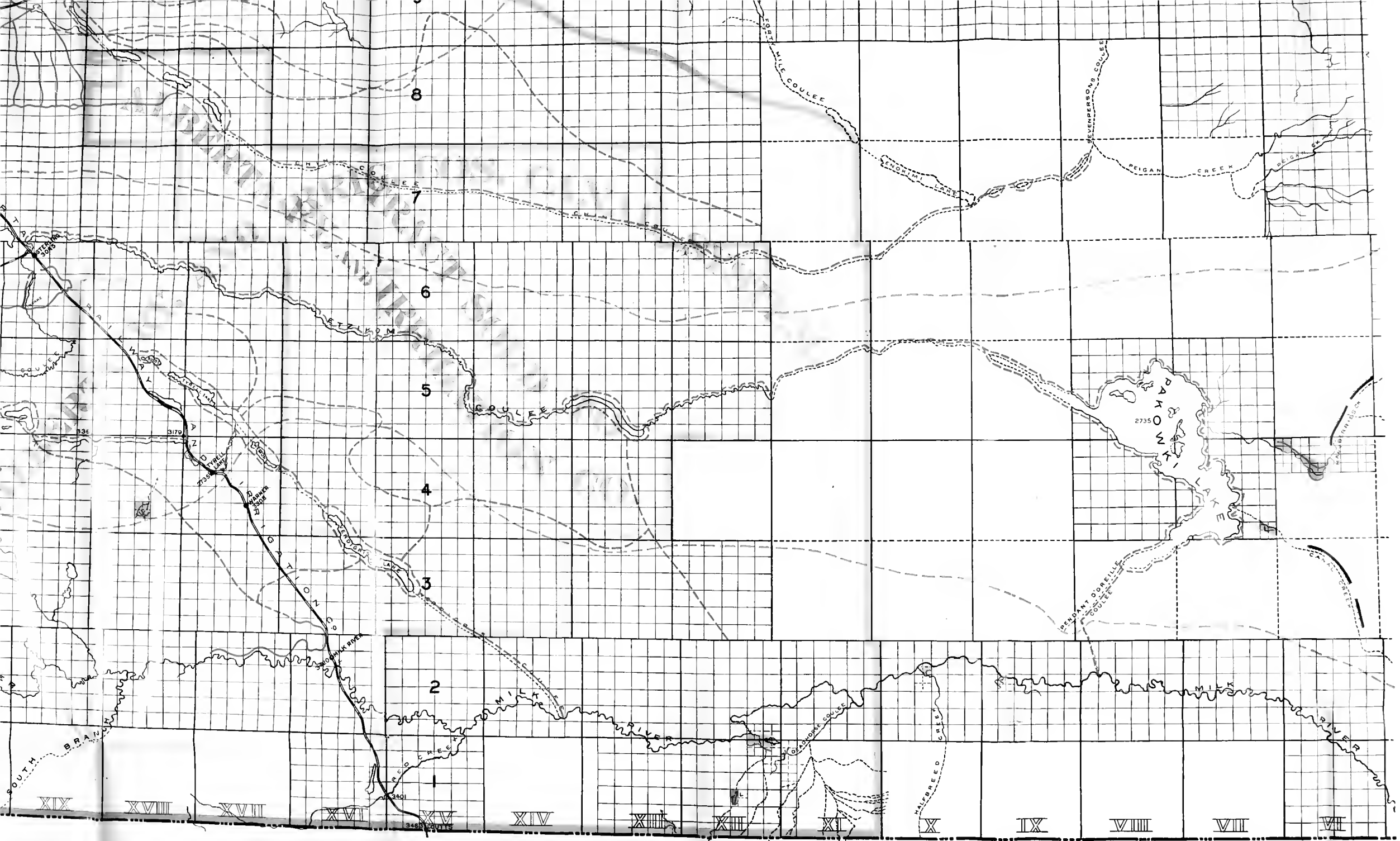








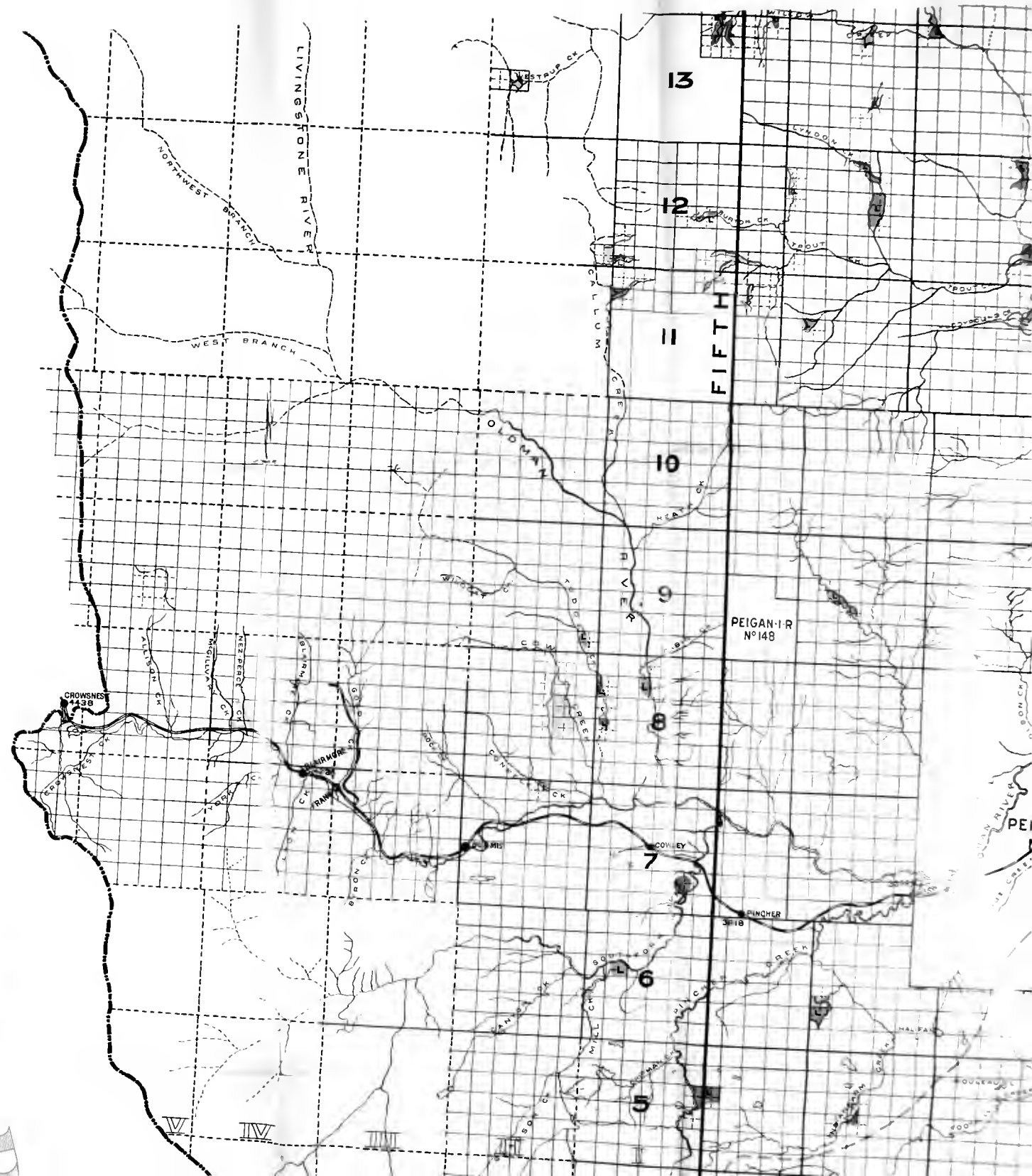


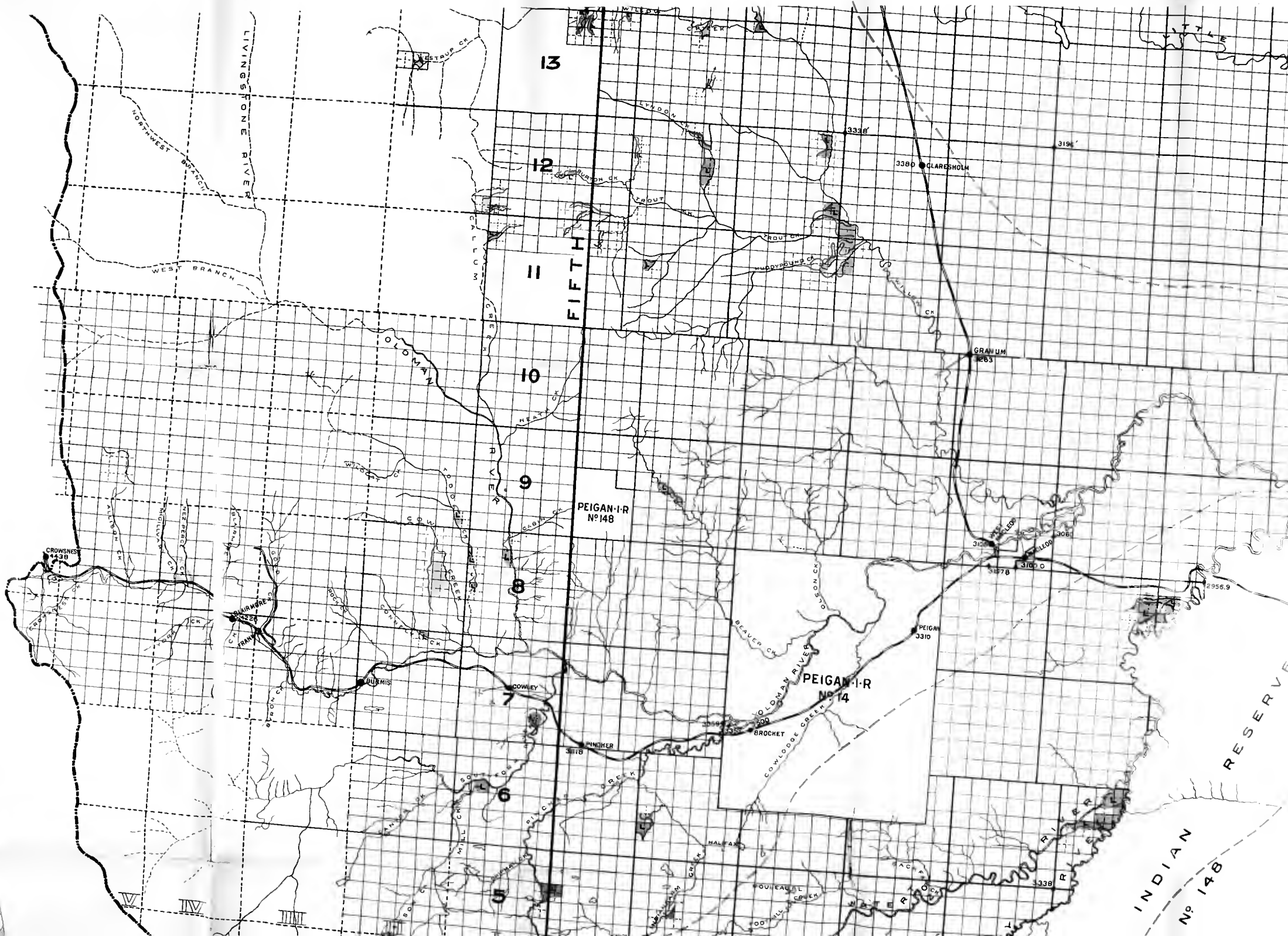




H

QUOTIENT MAP



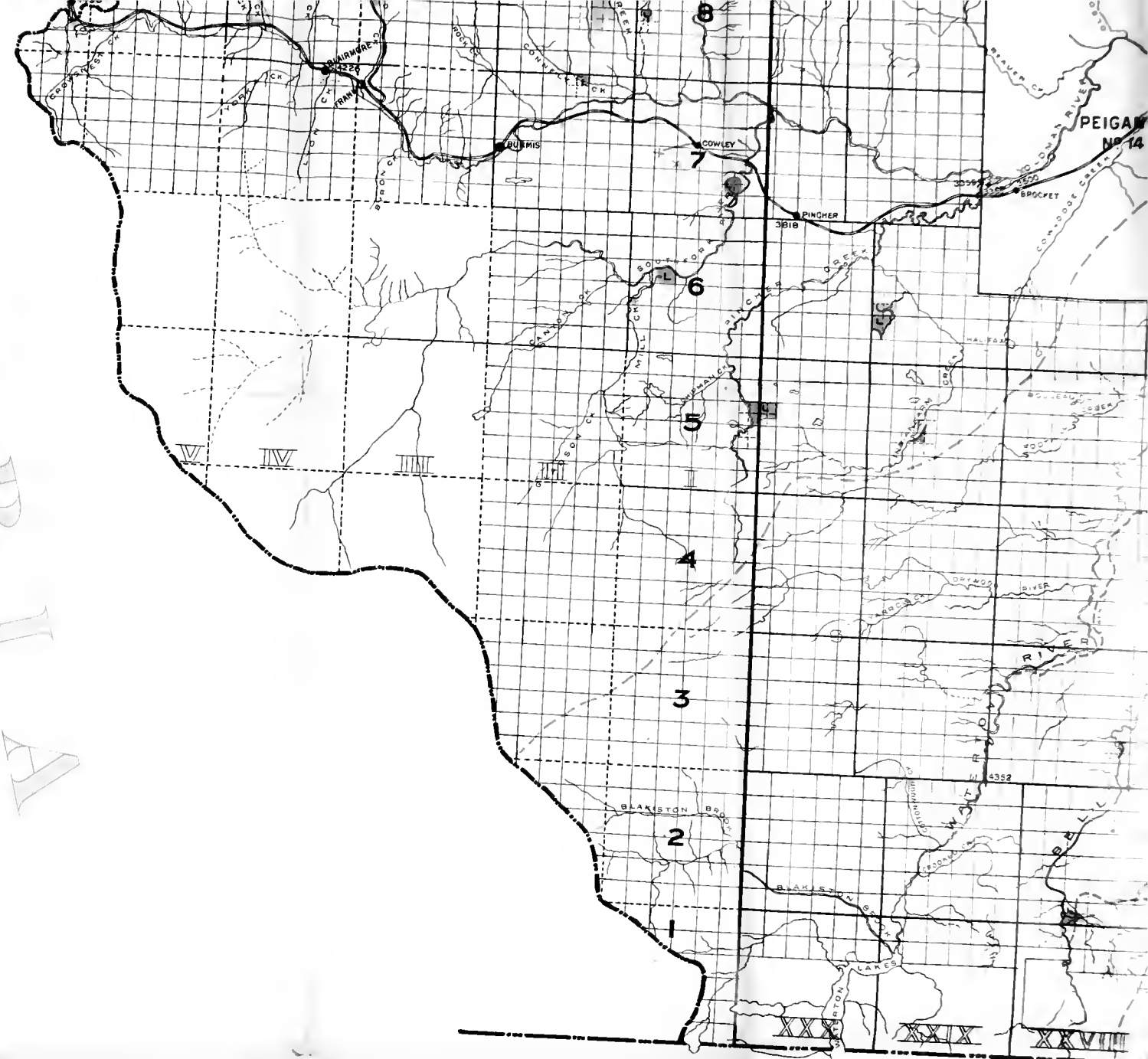


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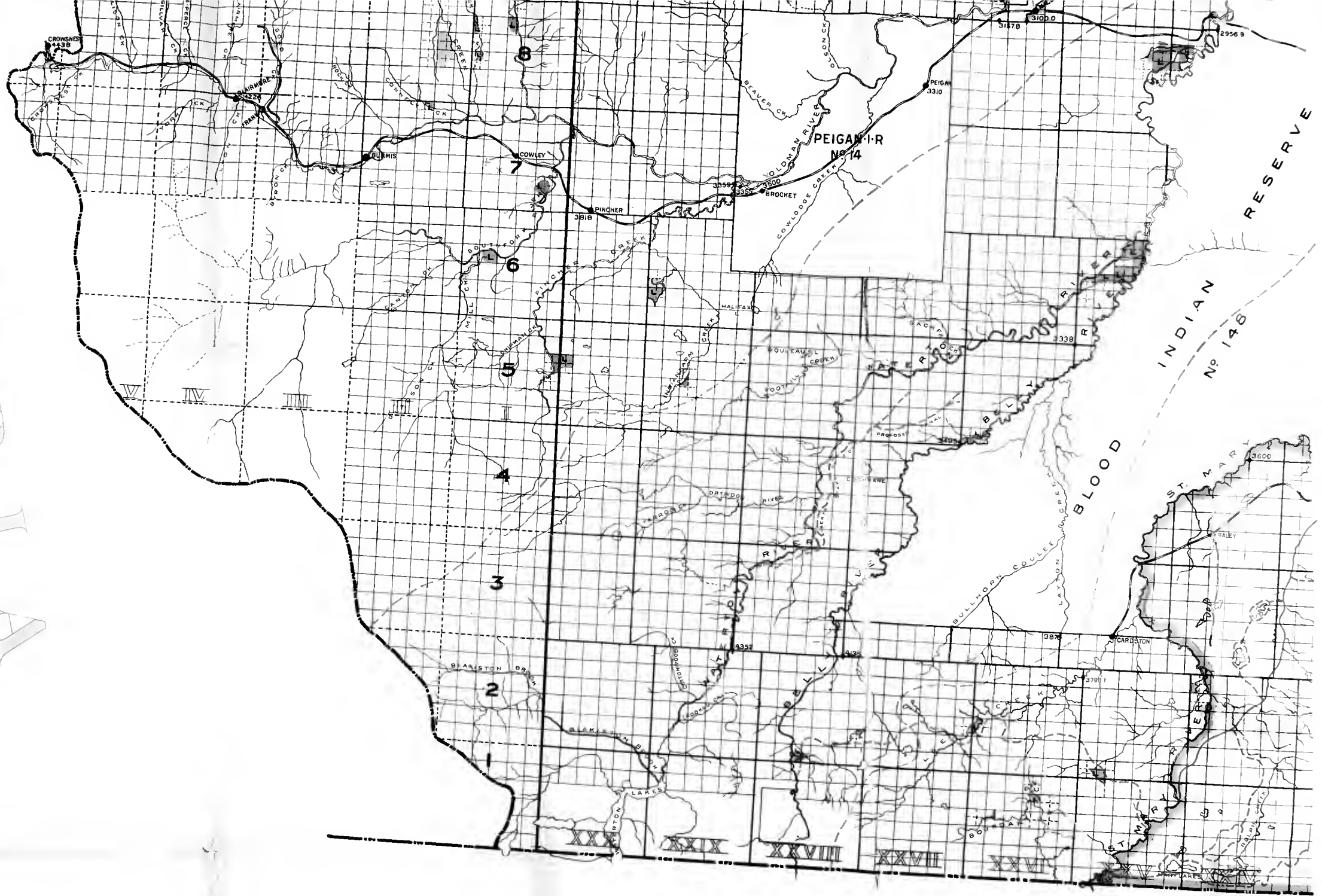
INDIAN RESERVE  
No 148



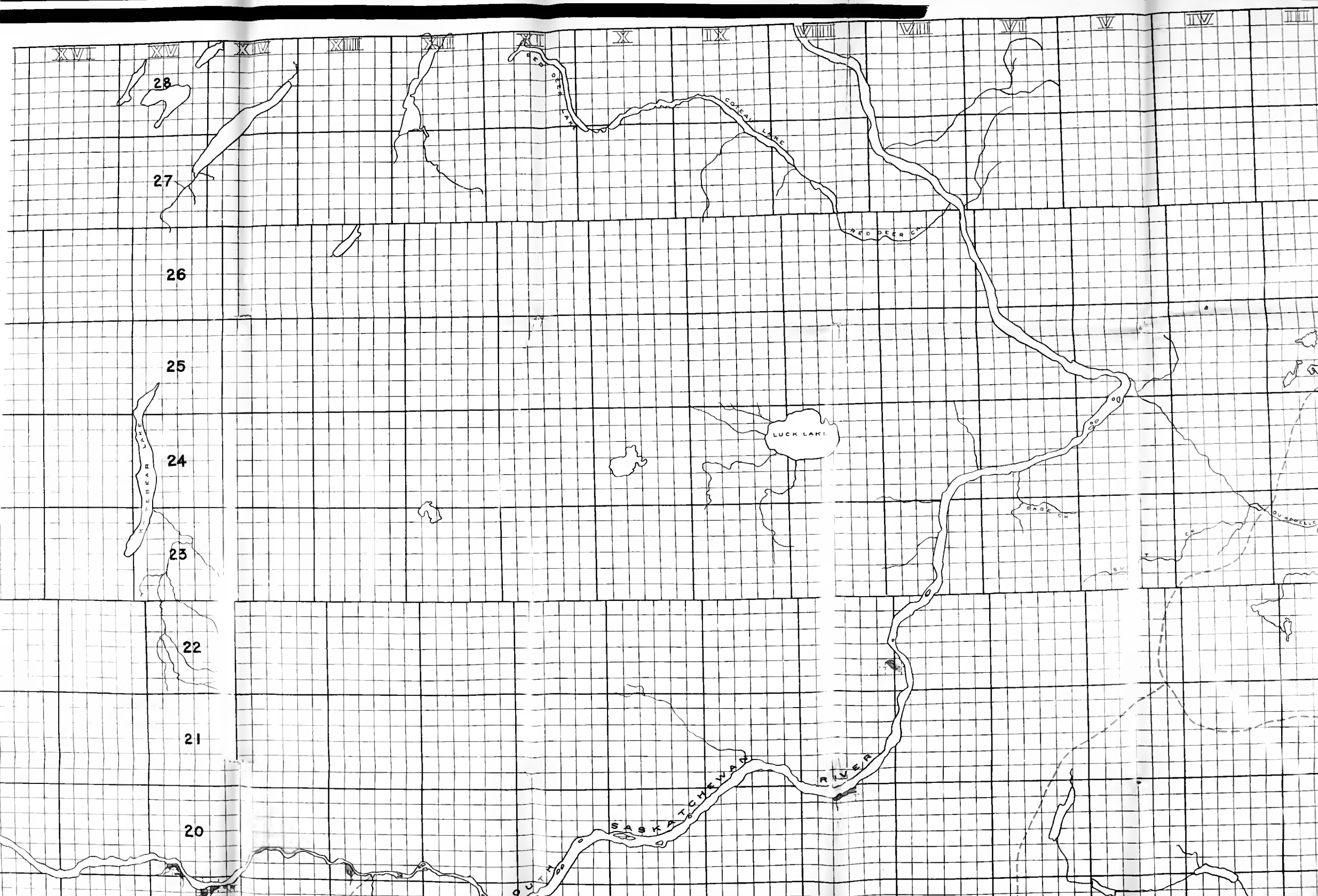
# WUMBIA



# MINIBIA







XVI

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RED BEAR C.

COLEMAN LAKE

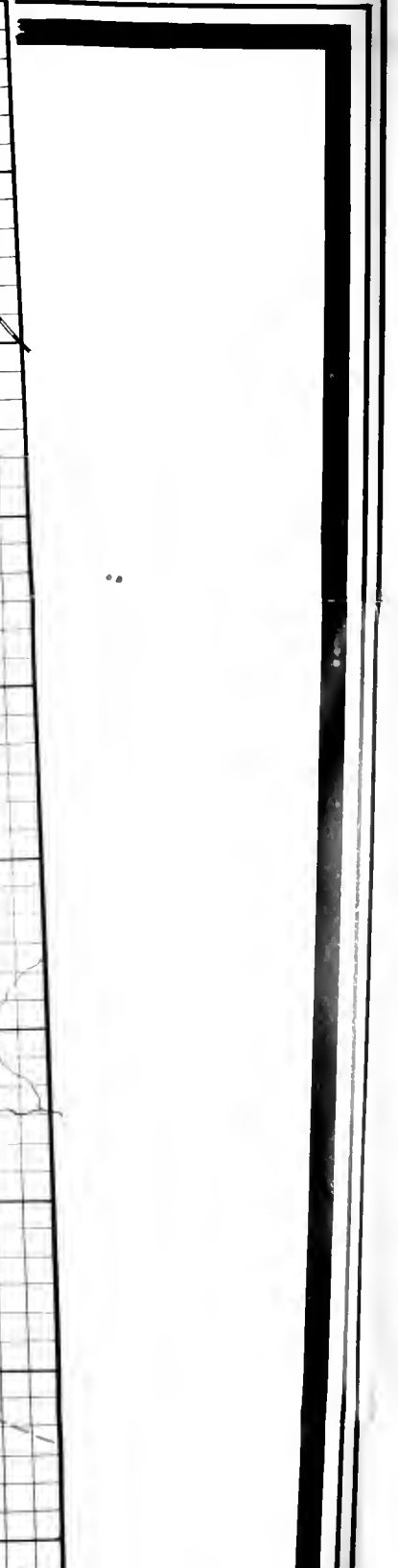
RED BEAR C.

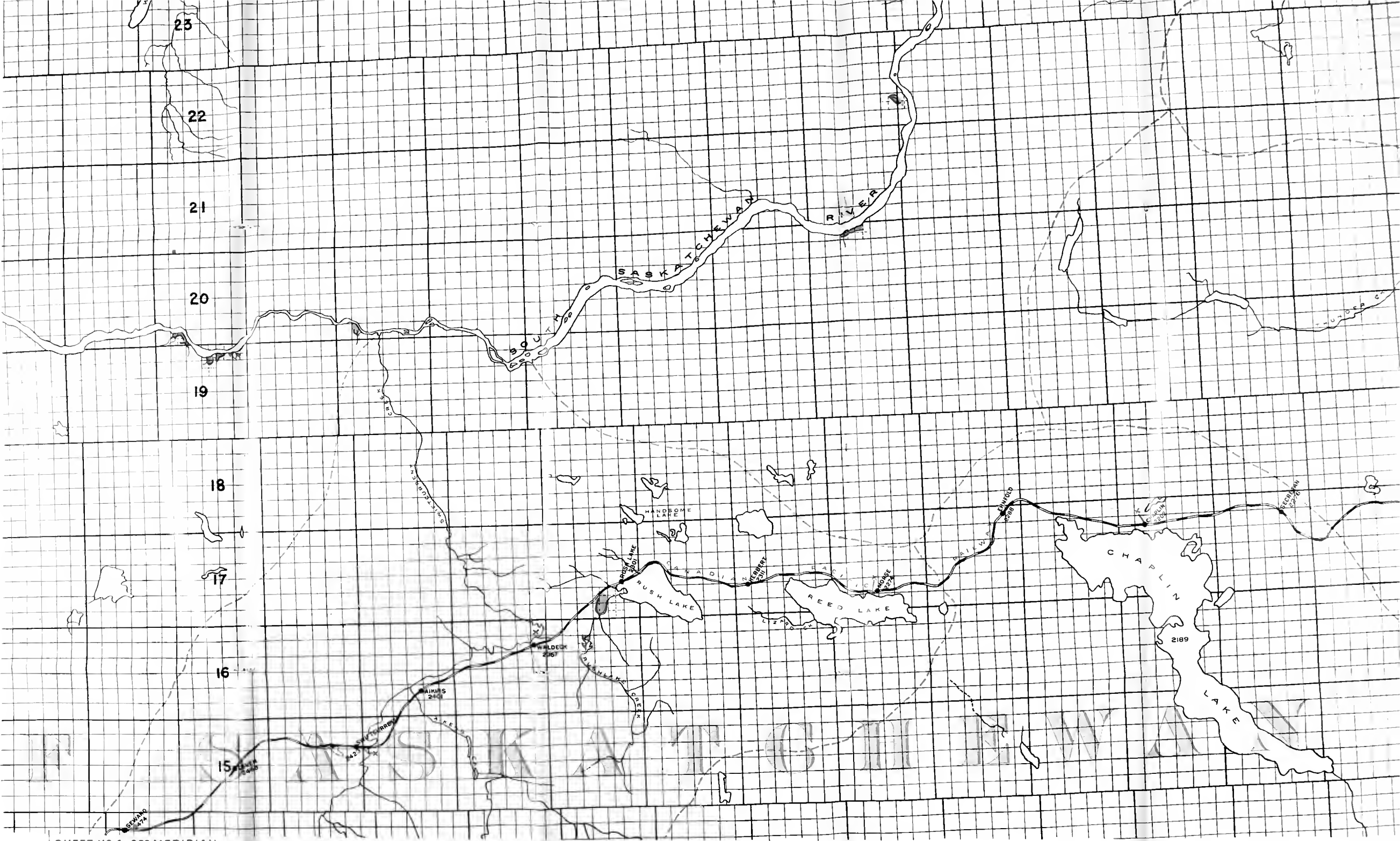
LUCK LAKE

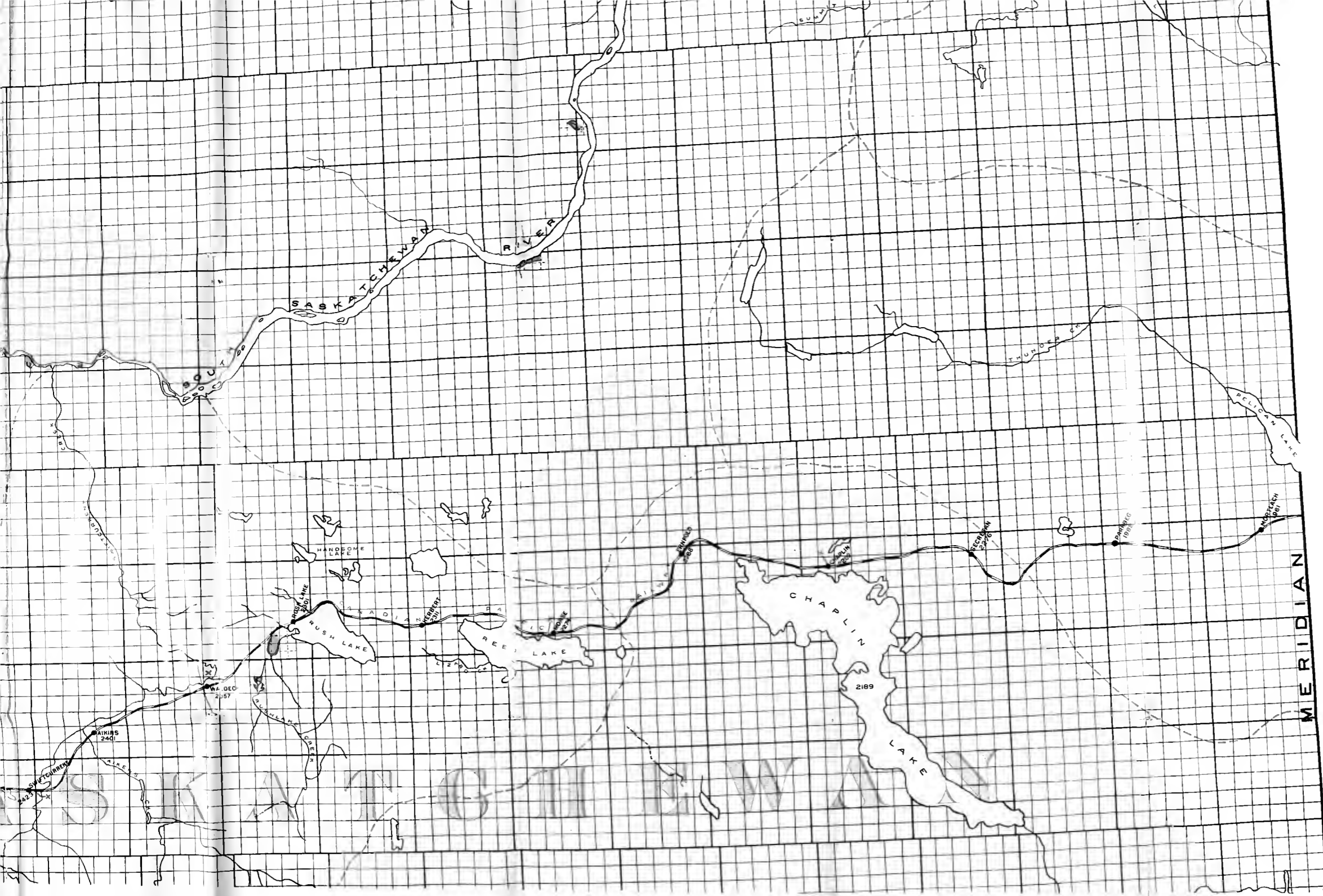
SAGS C.

OUAPPEL C.

SASKATCHEWAN RIVER



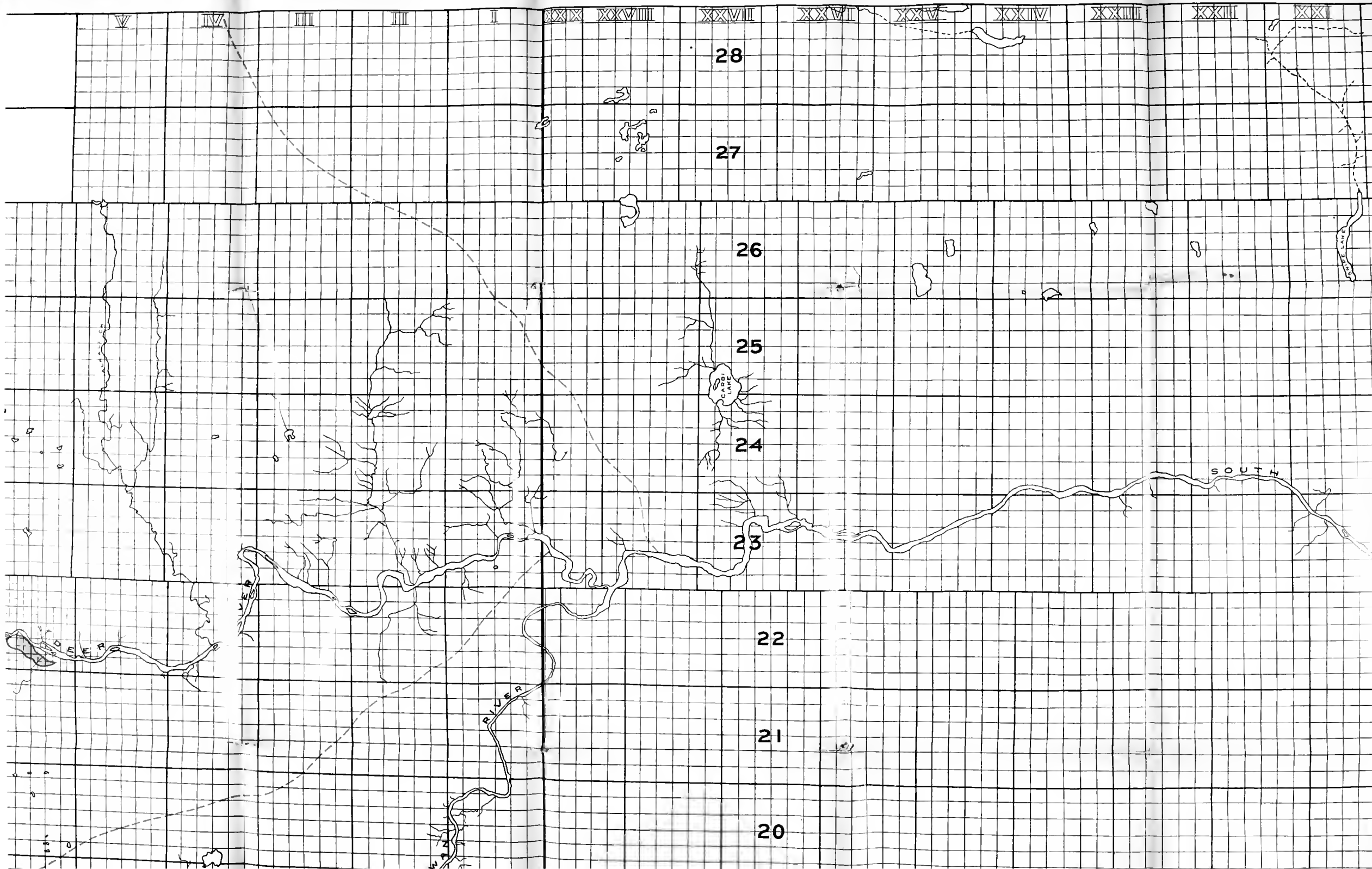




MERIDIAN







I XXX XXVIII XXVII XXVI XXV XXIV XXIII XXXI XXX XXIX XVIII XVII XVI

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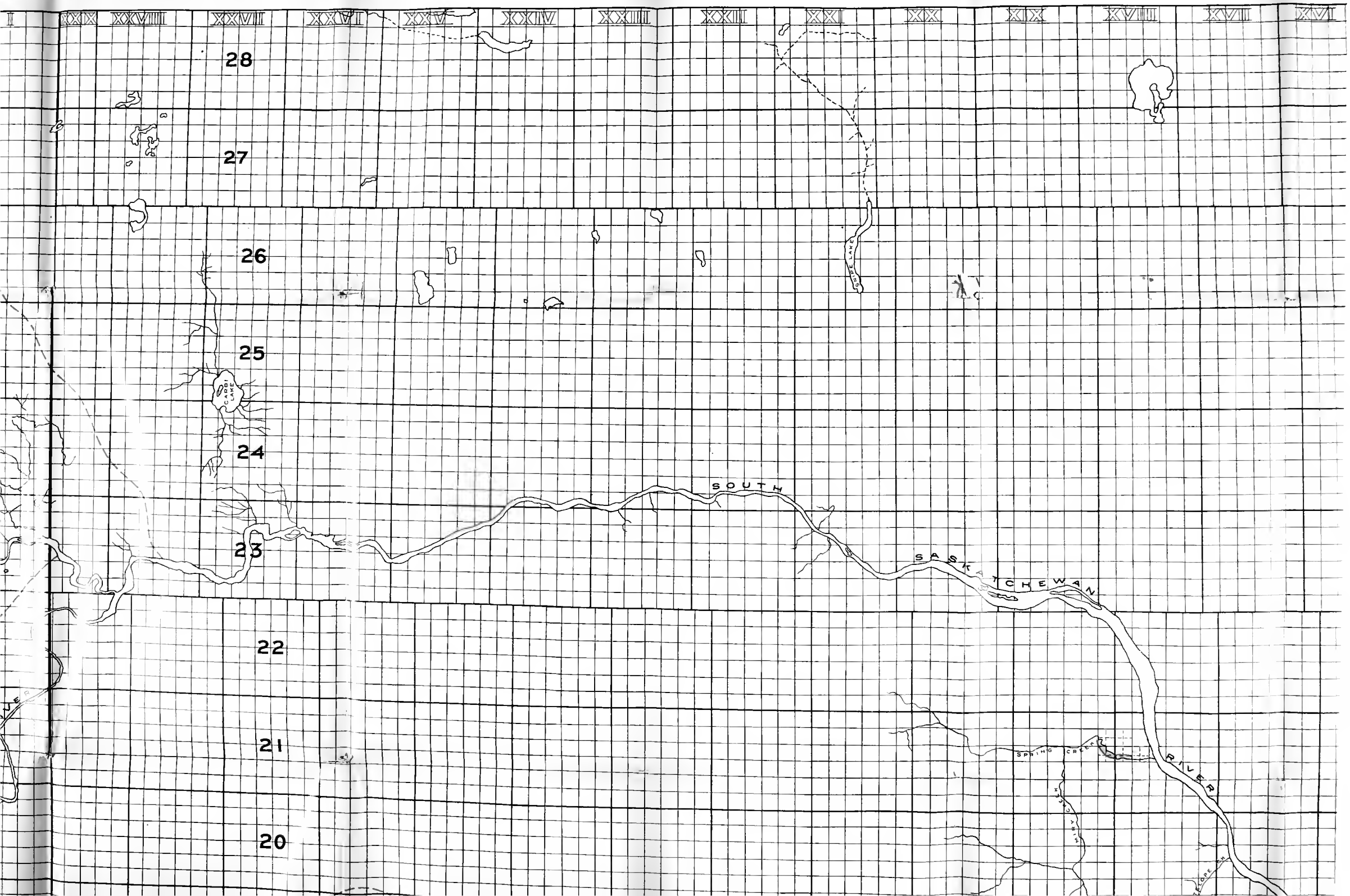
24

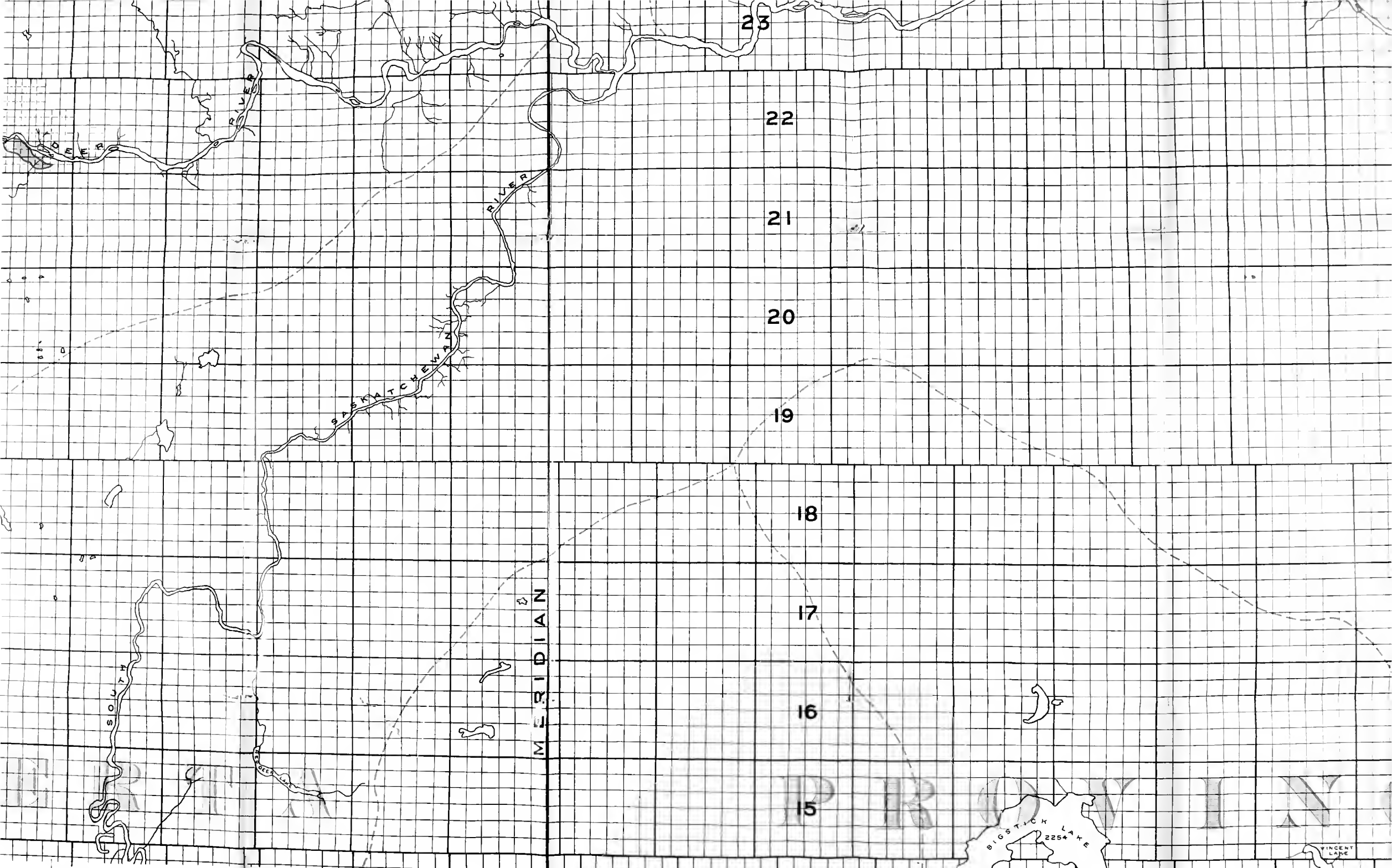
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4TH MERIDIAN

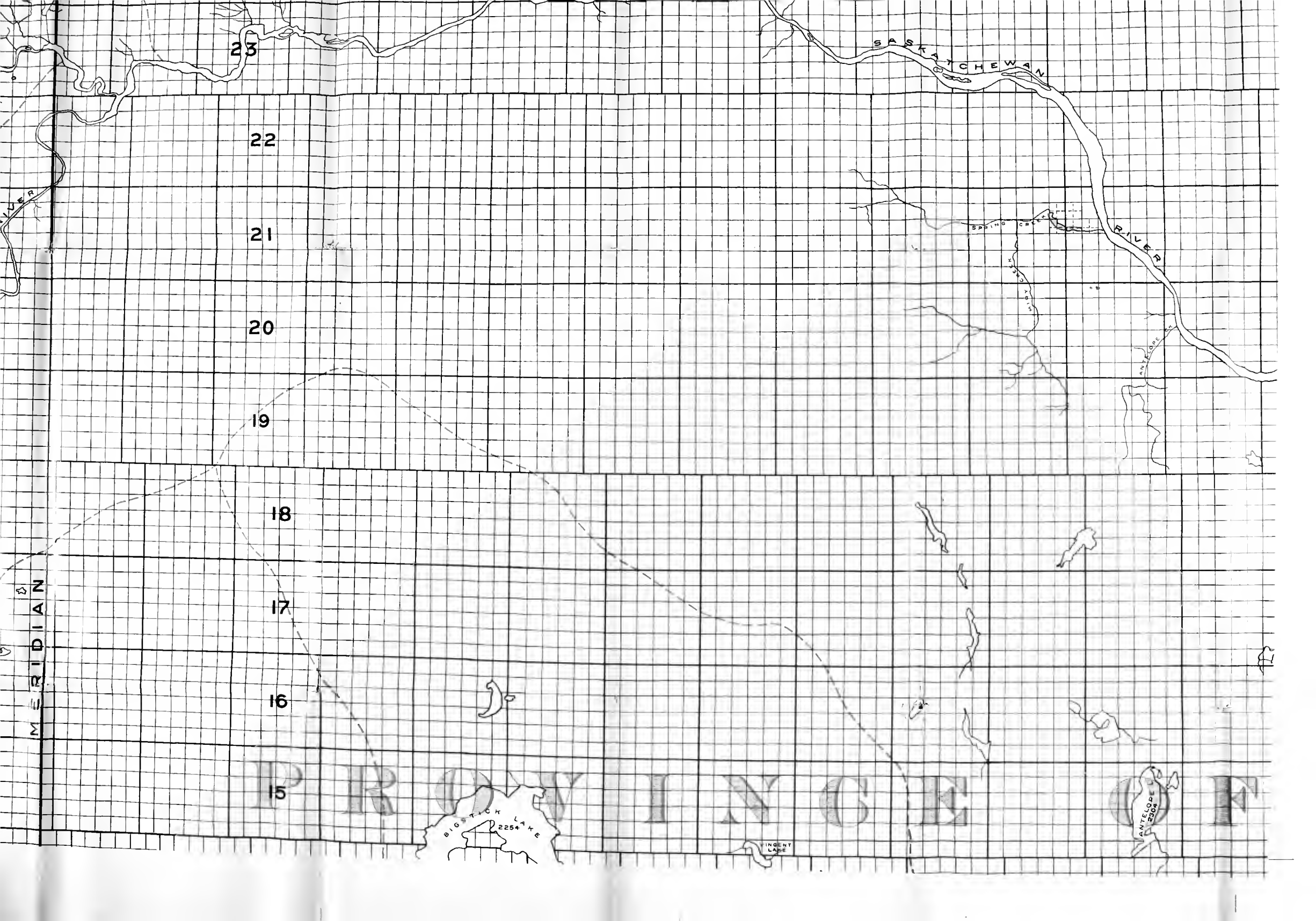
SOUTH SASKATCHEWAN RIVER

SASKATCHEWAN RIVER

RIVER

BIGSTICK LAKE  
2254

VINCENT LAKE



23

22

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19

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16

15

MERIDIAN

SASKATCHEWAN

SPRING CREEK

ANTELOPE RIVER

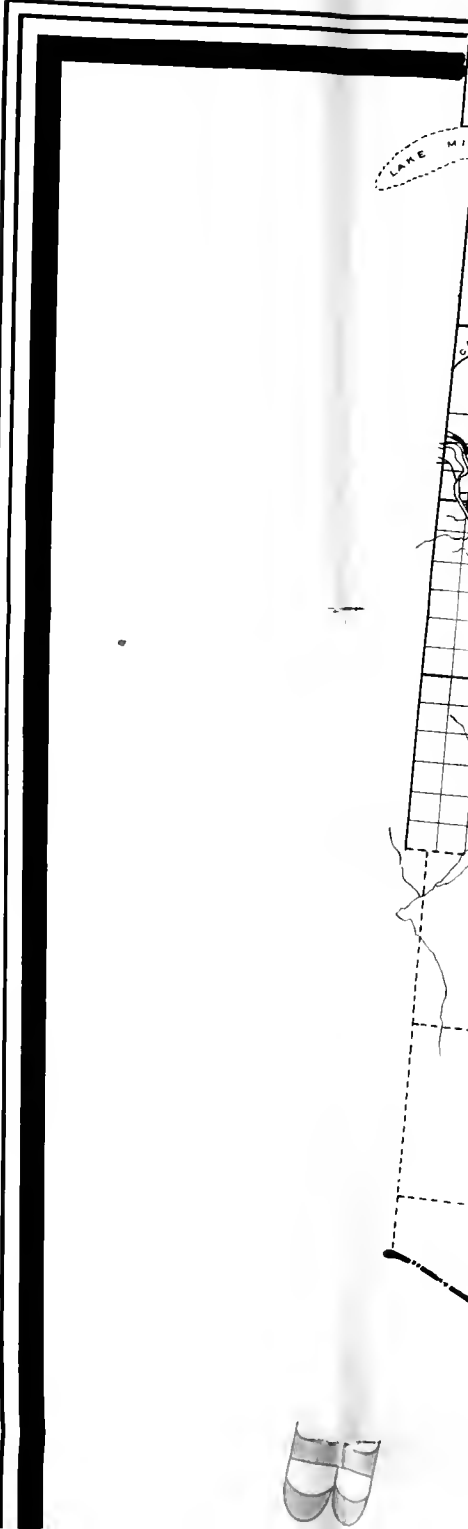
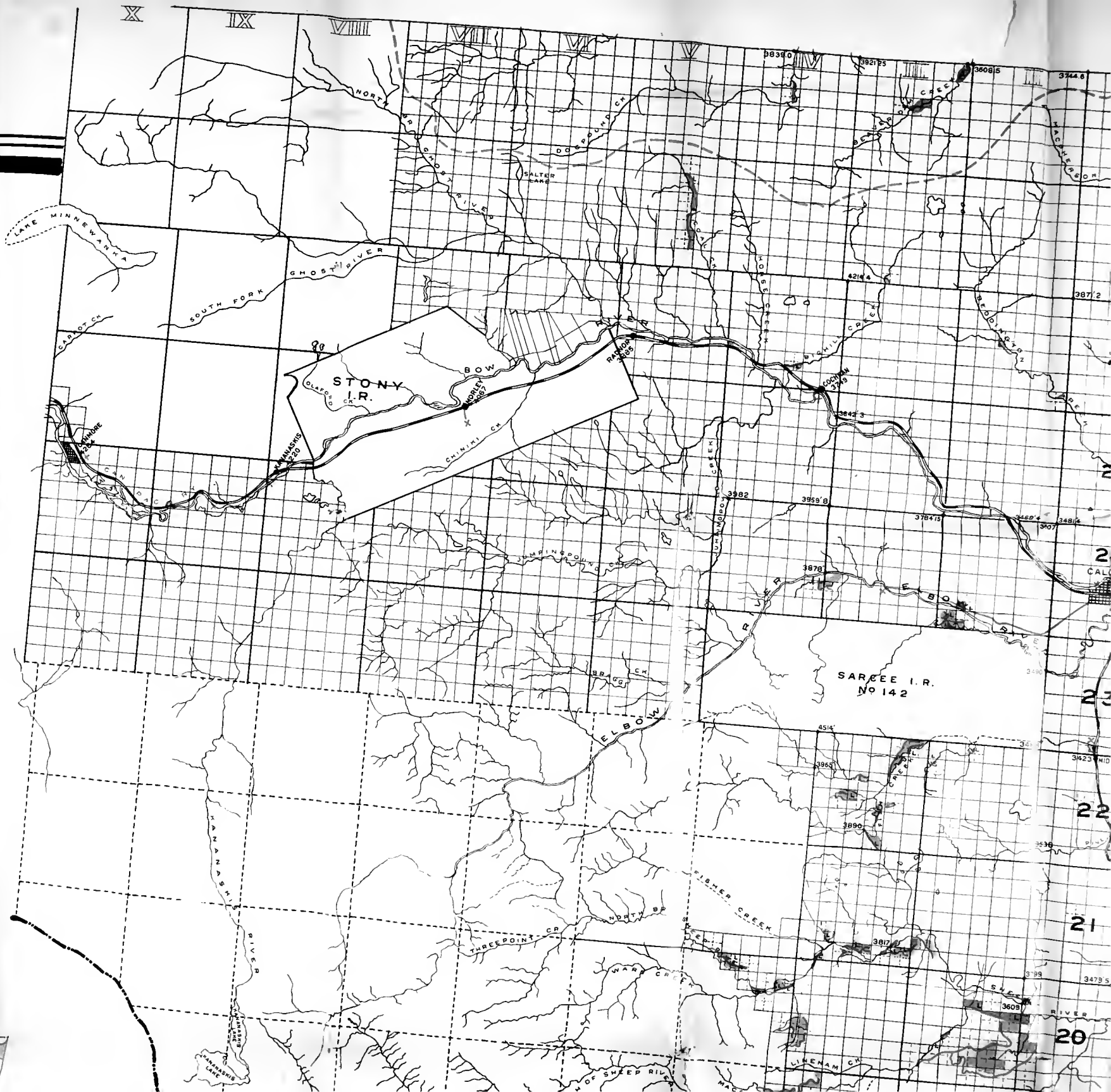
BIGSTICK LAKE  
225\*

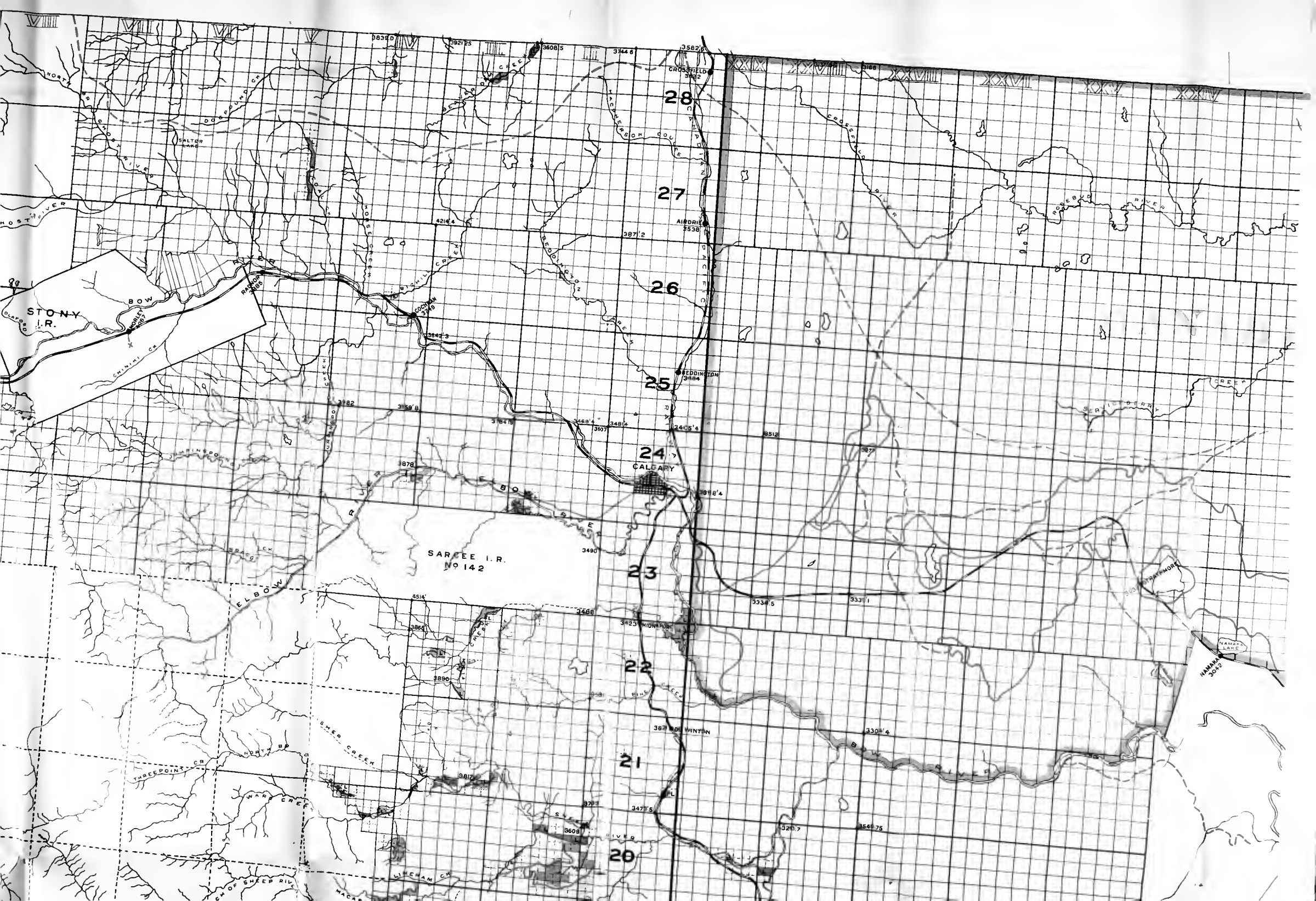
INGENT LAKE

ANTELOPE LAKE  
230\*

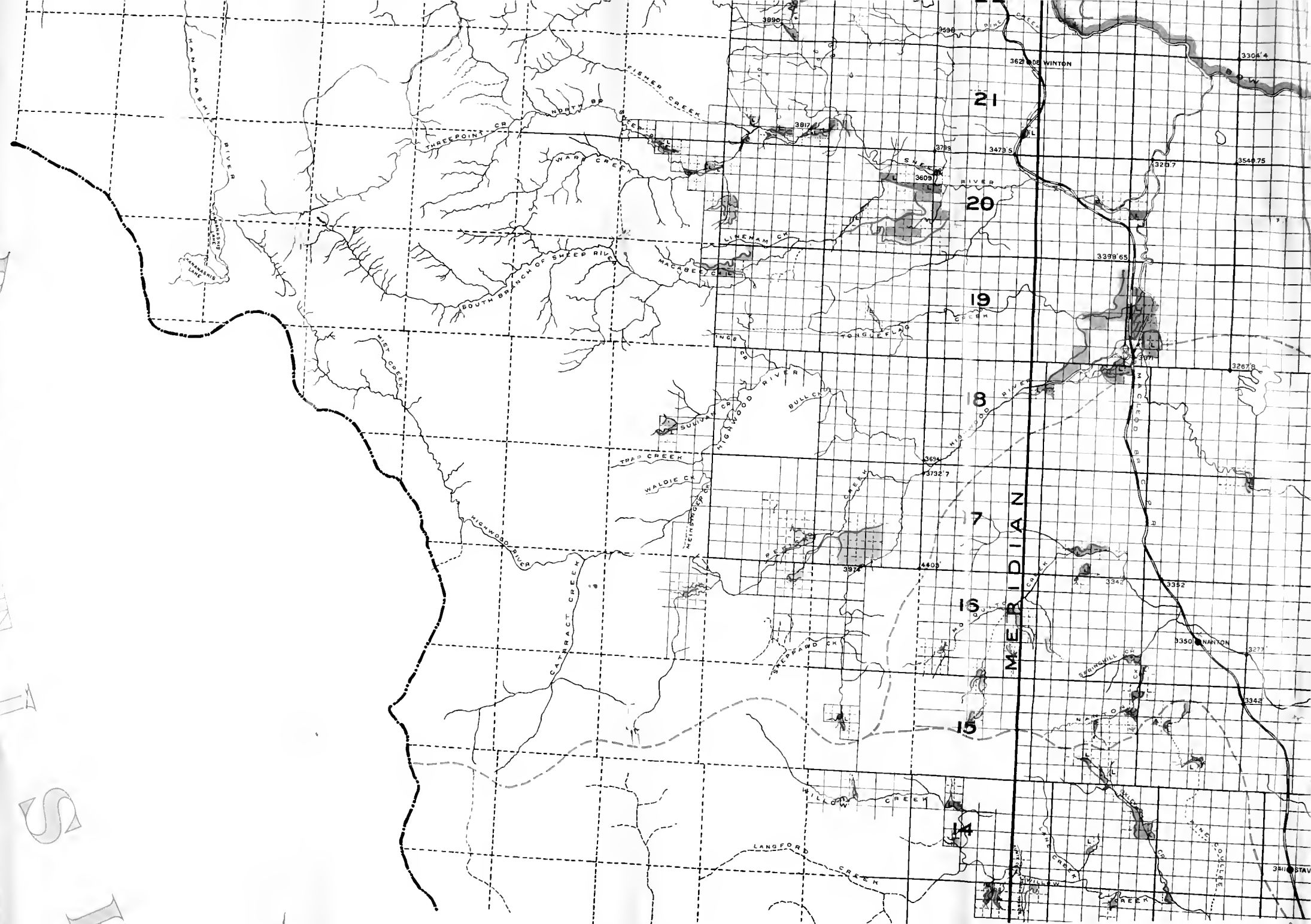
PROVINCE



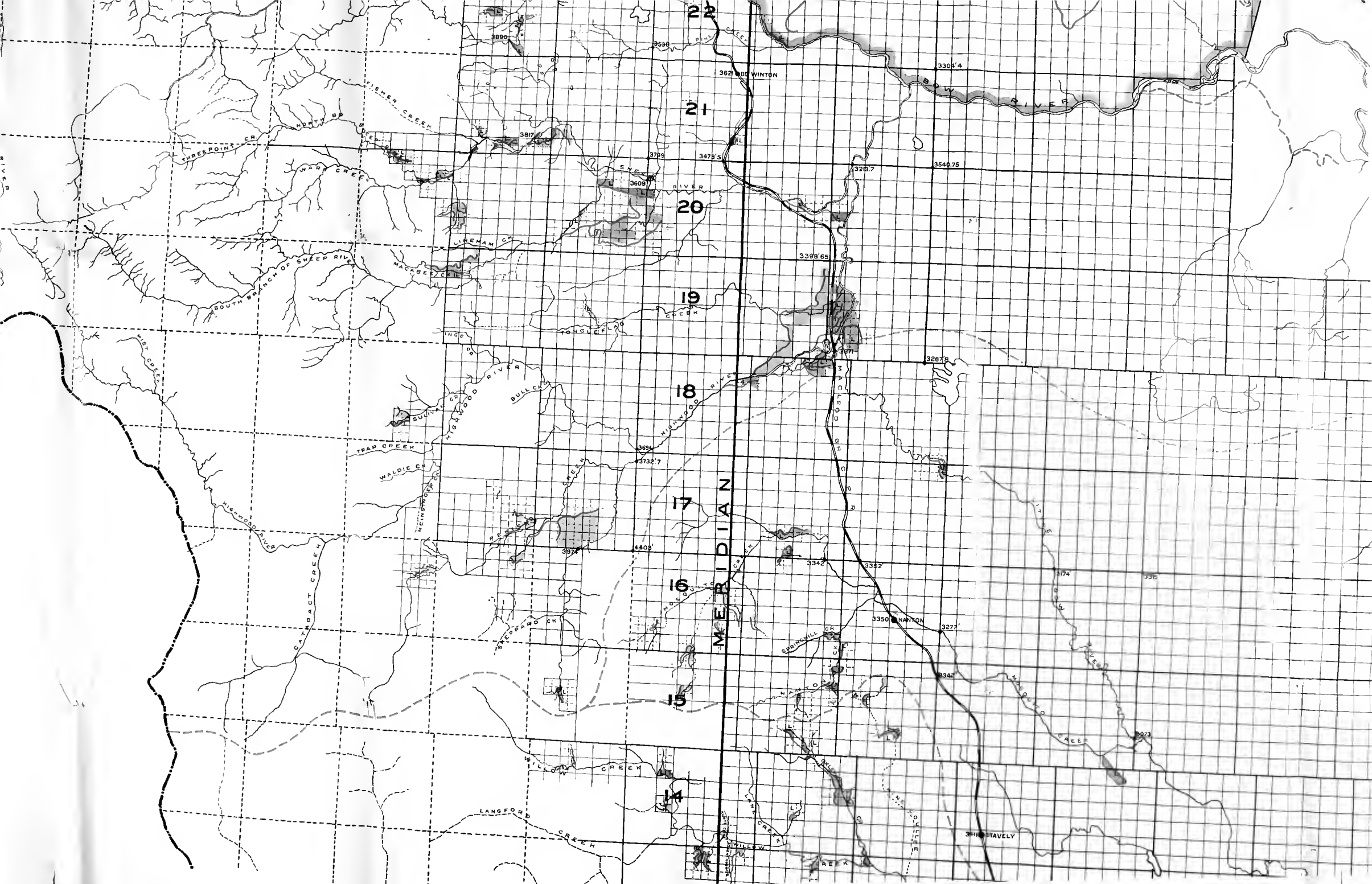




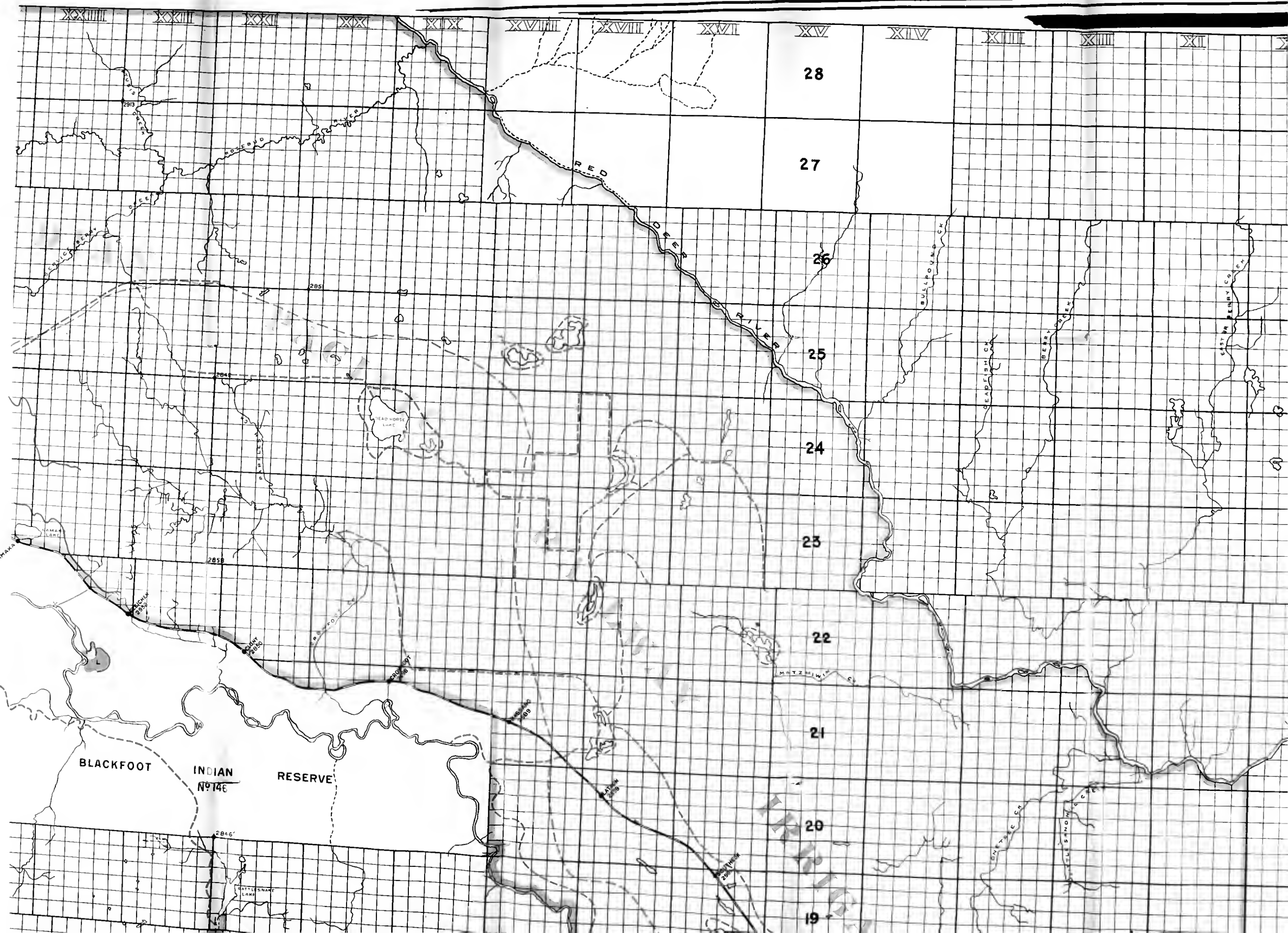
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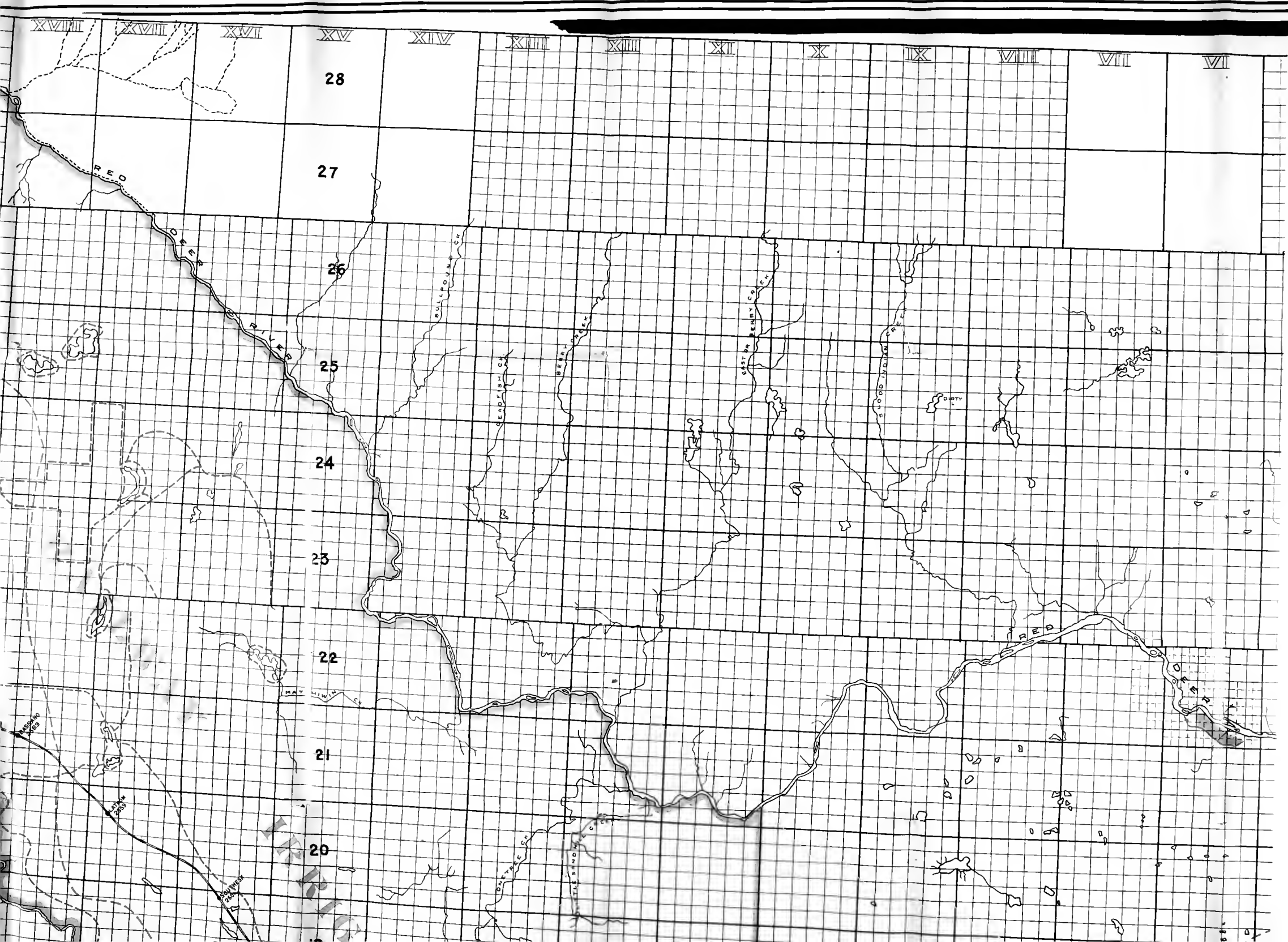


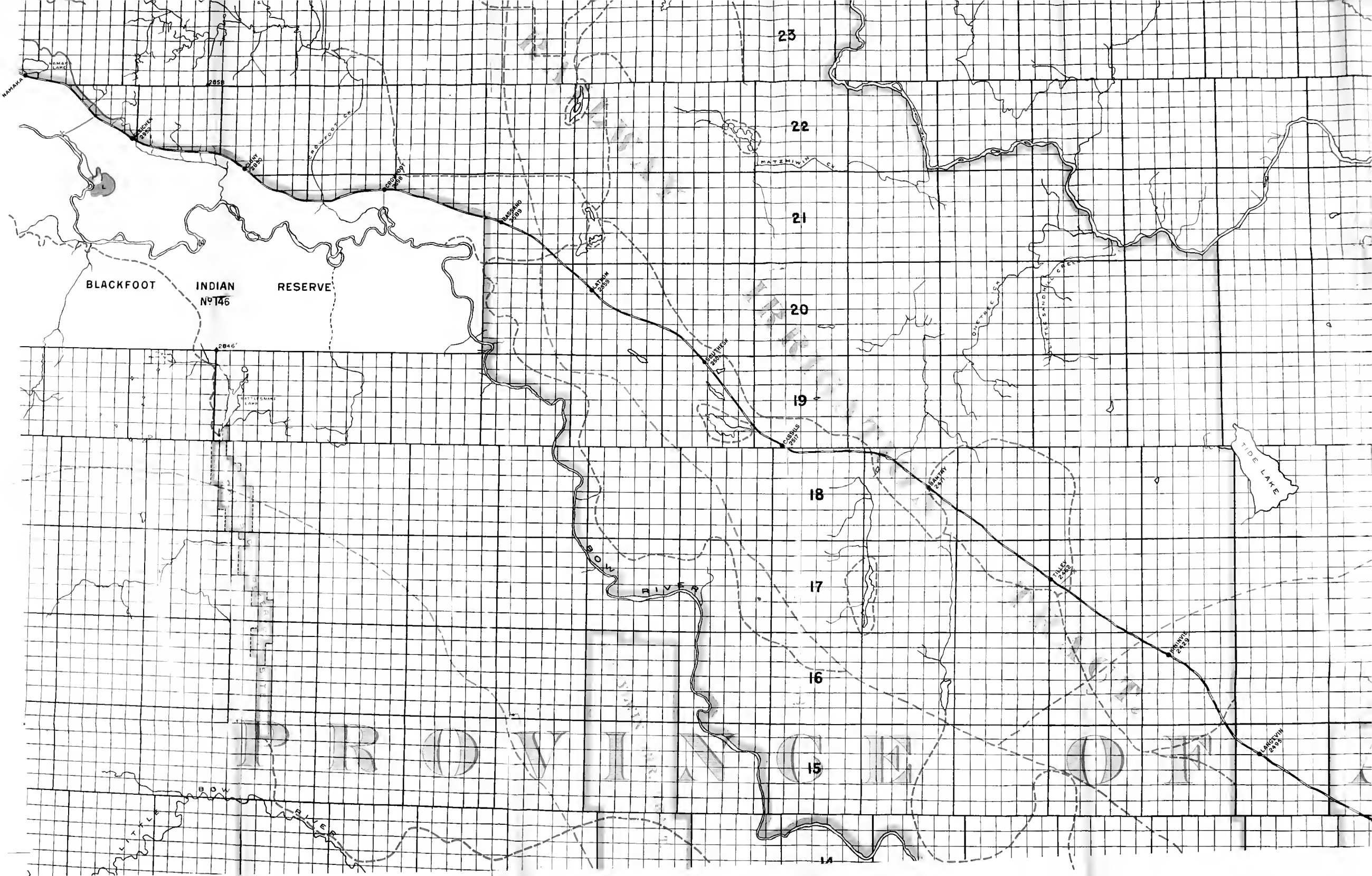




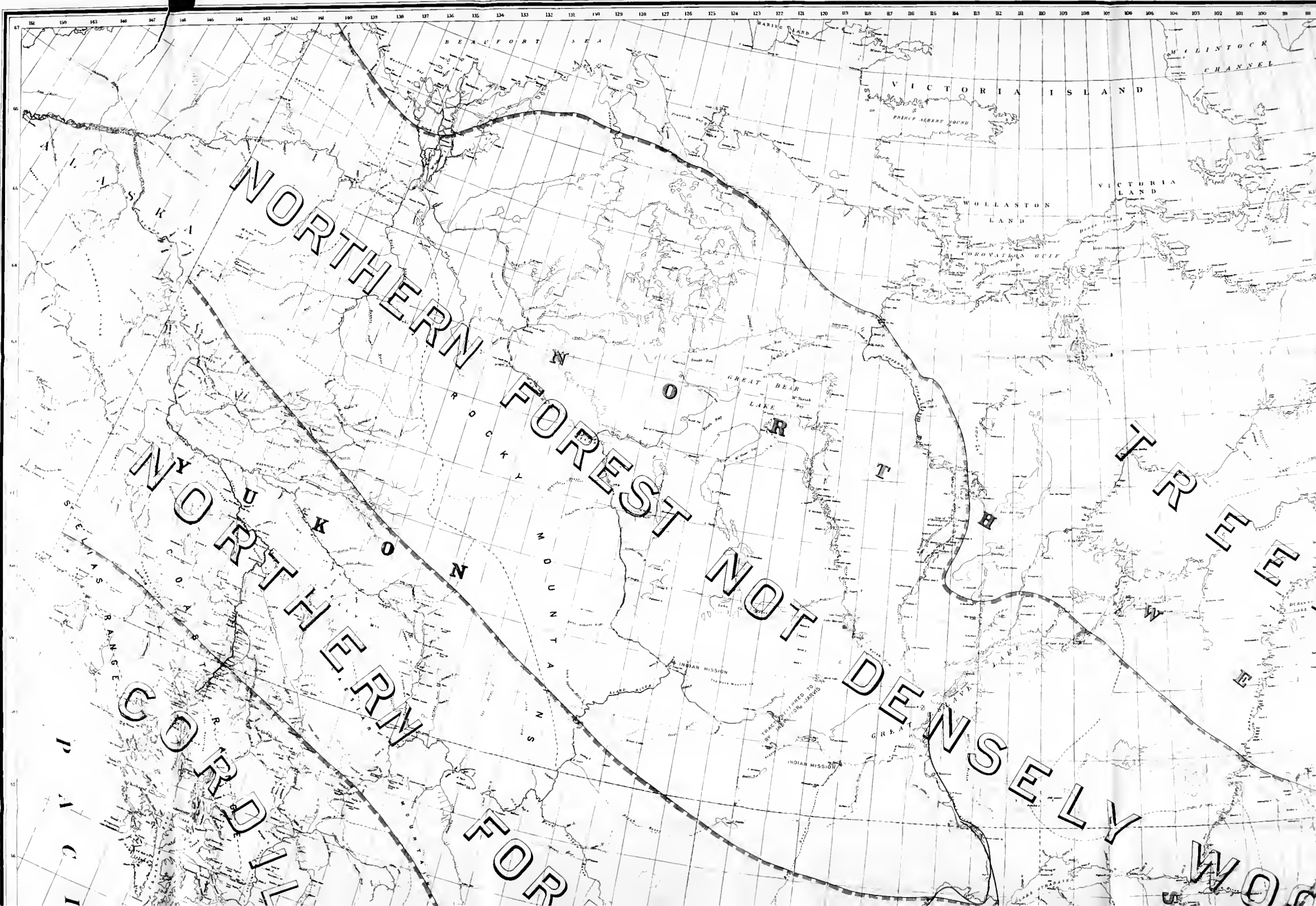












NORTHERN FOREST  
NORTHERN MOUNTAINS  
GREAT BEAR LAKE  
WORLD

BEAUFORT SEA

VICTORIA ISLAND

MCLINTOCK CHANNEL

WOLLASTON LAND

CORVATKA GULF

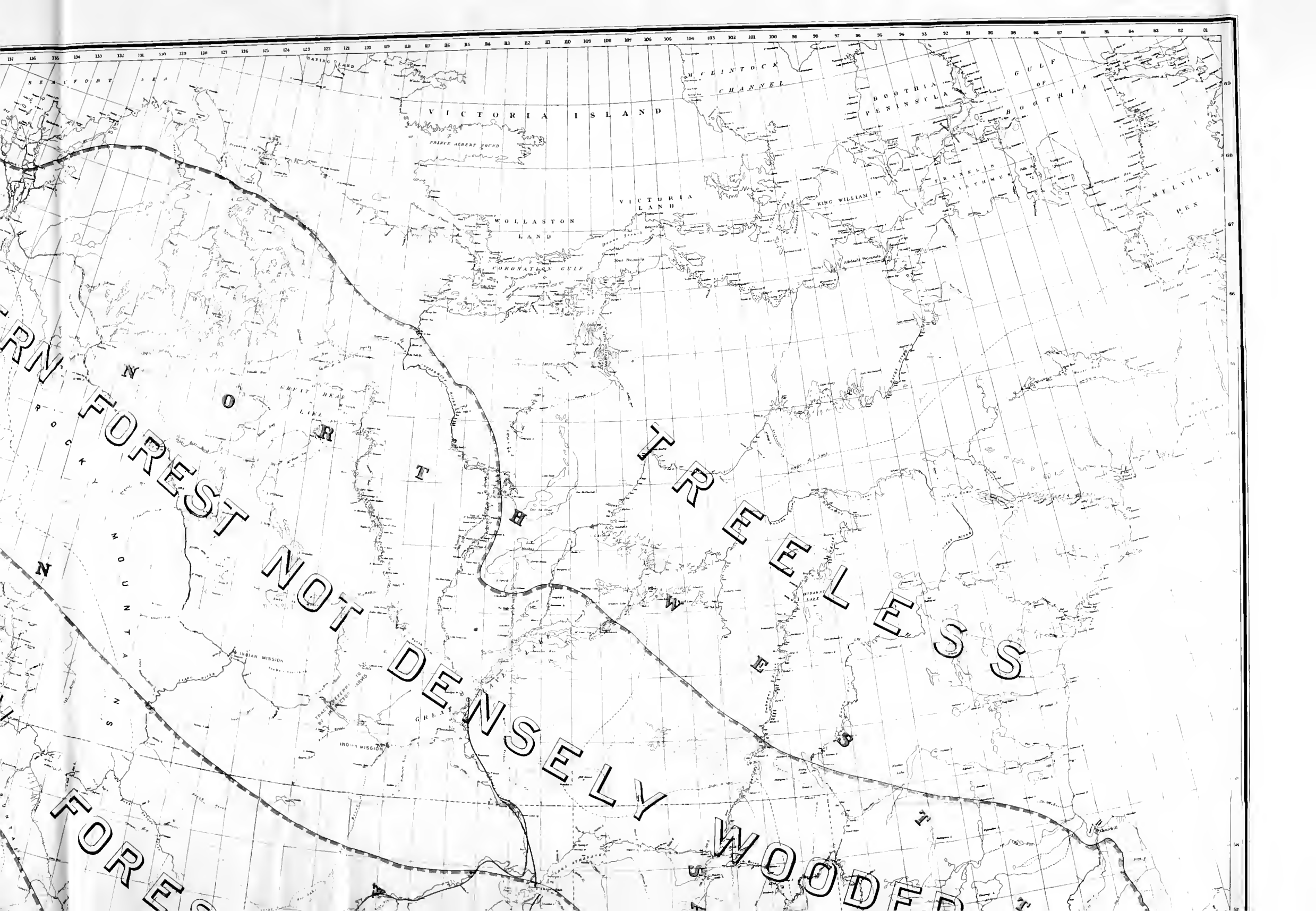
GREAT BEAR LAKE

MOUNTAIN RANGE

INDIAN MISSION

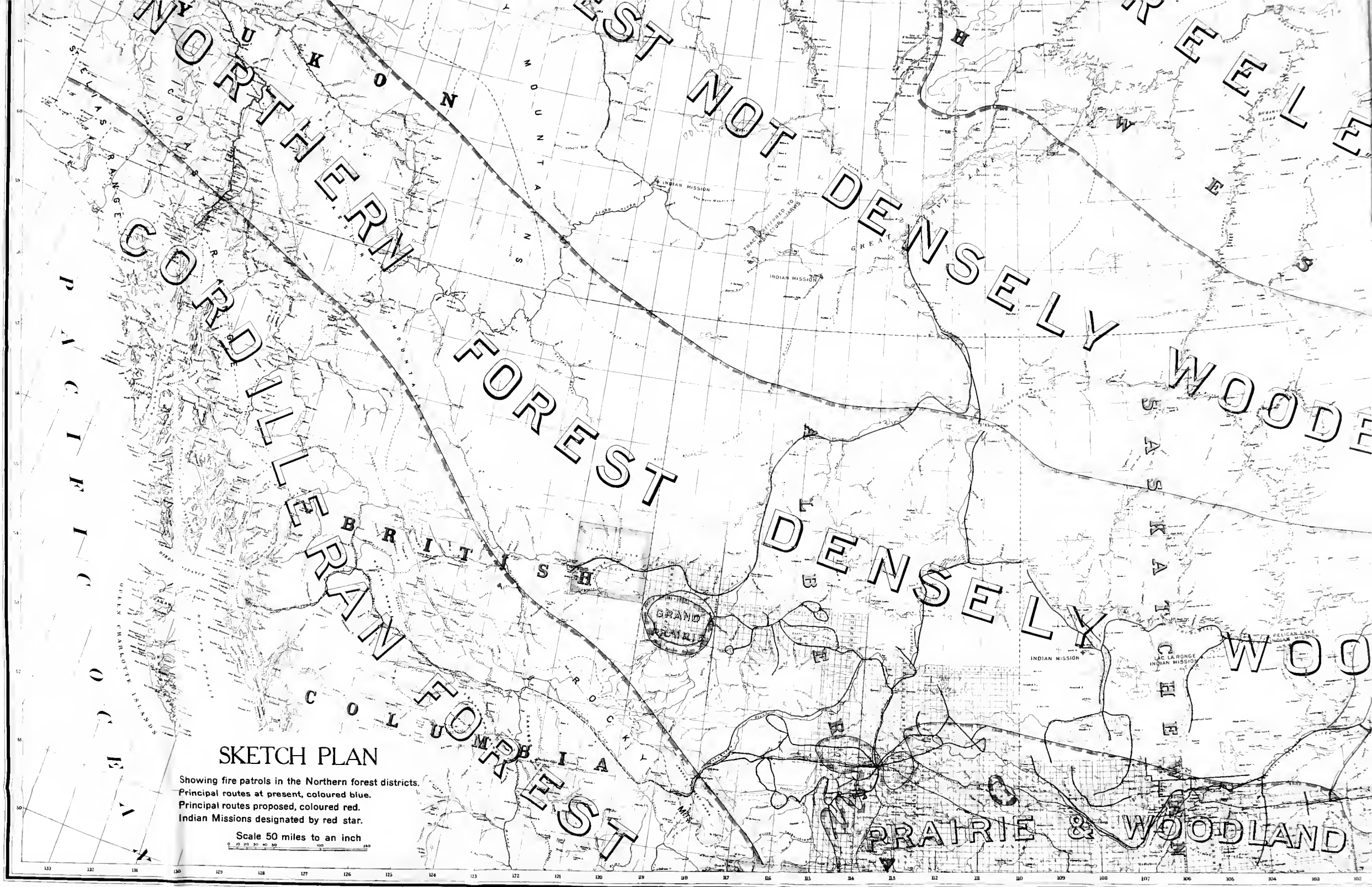
INDIAN MISSION

TRACK BELONGING TO MILLON-JAVOS



FOREST NOT DENSELY WOODED

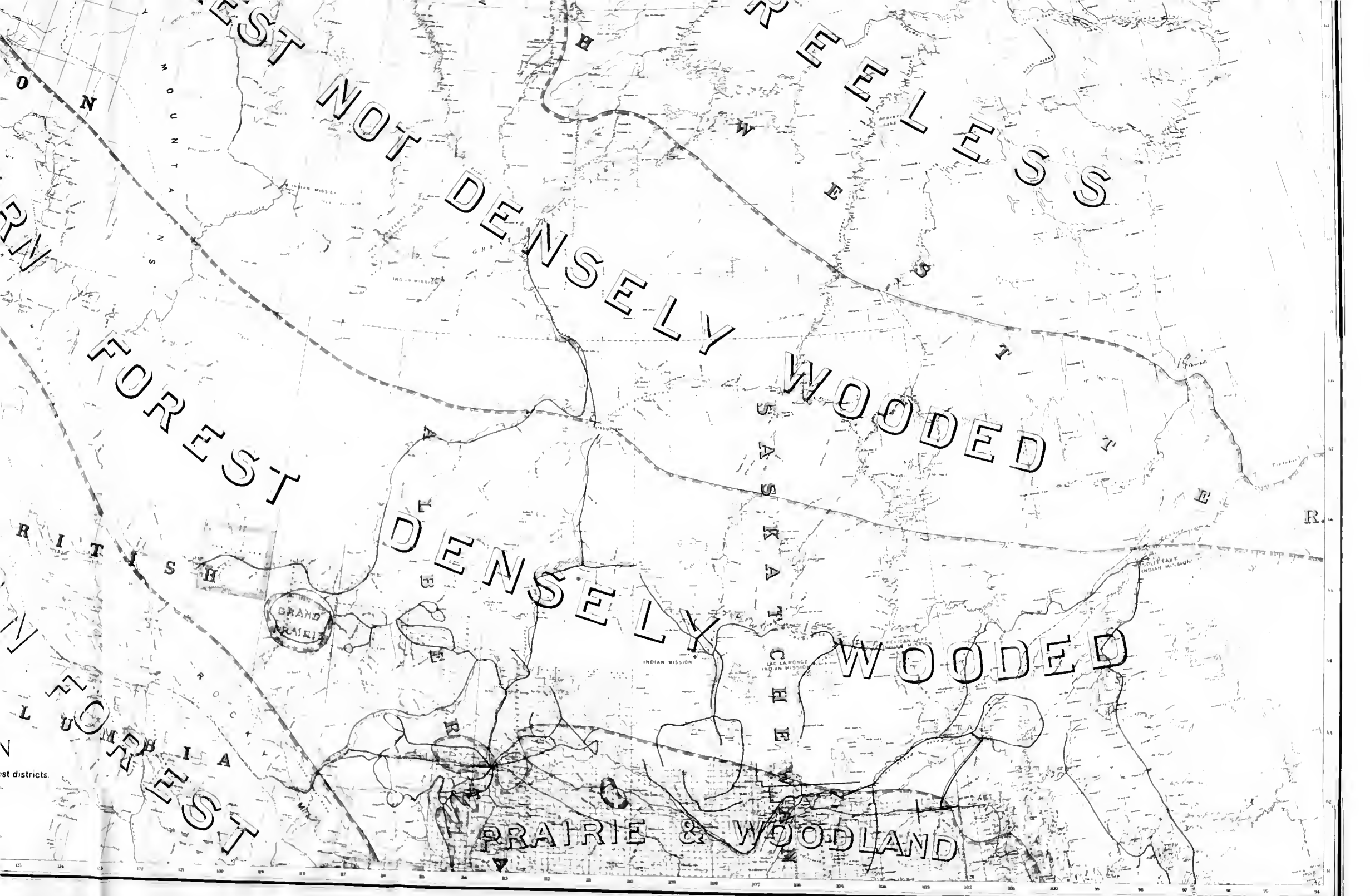




### SKETCH PLAN

Showing fire patrols in the Northern forest districts.  
 Principal routes at present, coloured blue.  
 Principal routes proposed, coloured red.  
 Indian Missions designated by red star.

Scale 50 miles to an inch  
 0 10 20 30 40 50 100 150



st districts.

112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74

DEPARTMENT OF THE INTERIOR

REPORT

OF THE

CHIEF ASTRONOMER

FOR THE

YEAR ENDING MARCH 31

**1909**

*PRINTED BY ORDER OF PARLIAMENT*



OTTAWA

PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST  
EXCELLENT MAJESTY

1910



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*Appendix 4.—Longitude and Latitude Observations.*

Map showing the position of the various Astronomical Stations established.

# REPORT

OF THE

## CHIEF ASTRONOMER AND INTERNATIONAL BOUNDARY COMMISSIONER.

DEPARTMENT OF THE INTERIOR,  
DOMINION ASTRONOMICAL OBSERVATORY,  
OTTAWA, CANADA. May 1, 1909.

W. W. CORY, Esq.,  
Deputy Minister of the Interior,  
Ottawa.

SIR,—I have the honour to present the report of the Astronomical Branch of the Department of the Interior for the year ending 31st March, 1909.

The correspondence in the twelve months was:—

|                            |       |
|----------------------------|-------|
| Letters received. . . . .  | 1,841 |
| Letters sent. . . . .      | 2,997 |
| Accounts examined. . . . . | 815   |

The work of the photographer was as follows:—

|                            |   |   |    |                   |       |
|----------------------------|---|---|----|-------------------|-------|
| Survey plates (developed), | 8 | x | 10 |                   | 360   |
| “                          | “ | “ | “  | 11 x 14 . . . . . | 40    |
| “                          | “ | “ | “  | 16 x 20 . . . . . | 161   |
| “                          | “ | “ | “  | 4½ x 6½ . . . . . | 1,158 |
|                            |   |   |    | —————             | 1,719 |
| Films                      | “ | “ | “  | 3¼ x 5½ . . . . . | 180   |
| “                          | “ | “ | “  | 5 x 7 . . . . .   | 1,104 |
| “                          | “ | “ | “  | 4¾ x 6½ . . . . . | 120   |
|                            |   |   |    | —————             | 1,404 |
| Bromide prints             | “ | “ | “  | 4 x 14 . . . . .  | 24    |
| “                          | “ | “ | “  | 11 x 14 . . . . . | 1,208 |
| “                          | “ | “ | “  | 16 x 20 . . . . . | 527   |
| “                          | “ | “ | “  | 9 x 36 . . . . .  | 469   |
| “                          | “ | “ | “  | 12 x 30 . . . . . | 61    |
| “                          | “ | “ | “  | 24 x 36 . . . . . | 69    |
| “                          | “ | “ | “  | 20 x 24 . . . . . | 23    |
|                            |   |   |    | —————             | 2,381 |
| Blue prints                | “ | “ | “  | 24 x 36 . . . . . | 10    |
| Contact prints             | “ | “ | “  | 4 x 6 . . . . .   | 531   |
| “                          | “ | “ | “  | 5 x 7 . . . . .   | 3,338 |
| “                          | “ | “ | “  | 8 x 10 . . . . .  | 189   |
|                            |   |   |    | —————             | 4,058 |
| Transparencies             | “ | “ | “  | 4 x 5 . . . . .   | 137   |
|                            |   |   |    | —————             | 137   |
| Total. . . . .             |   |   |    |                   | 9,709 |

The Library on March 31st last contained 3,400 volumes and 260 pamphlets. It increases by several hundred volumes each year, principally by exchanges with other Observatories and by the binding into volumes of the scientific periodicals, so that additional shelf space will be needed before very long. A card index of subjects and authors has been installed which has proved a great convenience.

The mechanical parts of a single-prism spectrograph designed by Mr. Plaskett for the avoidance of flexure, and of the solar spectrograph, of 23 feet focus, to be used in connection with the coelostat, have been constructed in the workshop.

The pivots of the meridian circle, as received from the makers, having been found to be of too soft metal, rings of hardened steel were shrunk upon them, and turned to proper form. This was a very difficult piece of work on account of the extreme accuracy of figure which was required.

There were besides numerous small pieces of work for the Observatory, and many repairs and minor alterations to field instruments for the Boundary and Geodetic Surveys, keeping two mechanics constantly employed.

The equipment of the shop has been increased by a second lathe, avoiding thereby a considerable loss of the men's time. The workshop, which is in the basement of the building, is insufficiently lighted for the fine work which we require. It is also rather inconveniently small.

The practice of opening the Observatory to the public every Saturday evening has been continued, and is much appreciated. An astronomer is always present on that evening to exhibit the large telescope. There are also many day-time visitors to the Observatory who have then an opportunity of seeing the other instruments.

The number of visitors registering in the book from April 1, 1908, to March 31, 1909, is 2,646.

In this connection may be mentioned the meetings of the Royal Astronomical Society of Canada which are held monthly during the winter in the Normal School Hall or in the Public Library, when lectures on astronomical subjects are presented. The majority of these lectures have been given by officers of the Observatory. Lectures are also given in the Observatory in the afternoon, alternating with the evening lectures in the city. These afternoon meetings serve a very useful purpose in the exchange of ideas among members of the staff.

#### TIME SERVICE.

The ordinary work in connection with the time service has consisted, as in the past, of the necessary attention to the up-town service, the sending out of time signals to the telegraph company, dropping of the time-ball on Parliament Hill, supplying of mean and sidereal time by telephone to those requiring it, occasional rating of chronometers, testing of aneroid barometers, &c., together with the maintenance of the clocks and apparatus at the Observatory. The city service has been extended by the installation of electric dials in the Mint and the Archives Building, which are operated by a master clock in the Mint controlled directly from the Observatory. The dials were started at noon on September 19, though the master clock was not put under control for some time subsequently. It was decided by the Public Works Department, contrary to the original intention, not to instal clocks in the Printing Bureau at present. There were also, as usual, changes and additions in the other Government Buildings. Below is a list of the number of clocks in operation:—



SESSIONAL PAPER No. 25a

MINUTE DIALS.

|   | March 31,<br>1909. | March 31,<br>1908. |
|---|--------------------|--------------------|
| Parliament Building. . . . .              | 49                 | 46                 |
| East Block. . . . .                       | 36                 | 35                 |
| West Block. . . . .                       | 63                 | 61                 |
| Langevin Block. . . . .                   | 48                 | 48                 |
| Post Office . . . . .                     | 20                 | 20                 |
| Thistle Block. . . . .                    | 2                  | 2                  |
| Ottawa Electric Company. . . . .          | 1                  | 1                  |
| Mint. . . . .                             | 16                 | ..                 |
| Archives. . . . .                         | 7                  | ..                 |
| Observatory. . . . .                      | 28                 | 28                 |
|   | -----              | -----              |
|   | 270                | 241                |
| Program clock. . . . .                    | 1                  | 1                  |
| Seconds dials. . . . .                    | 3                  | 2                  |
| Tower clocks. . . . .                     | 2                  | 2                  |
|   | -----              | -----              |
| Total electrically driven clocks. . . . . | 276                | 246                |
| Secondary master clocks. . . . .          | 8                  | 7                  |
| Primary clocks. . . . .                   | 4                  | 4                  |
|   | -----              | -----              |
| Total. . . . .                            | 288                | 257                |

TRANSIT OBSERVATIONS.

Observations with the portable transits were taken on 142 nights, involving 281 determinations of clock error, as well as some observations for other purposes; on a number of nights two, and sometimes three, observers worked simultaneously, for determination of personal equation.

The relative personal equation of the Ottawa observers was in addition determined from the clock-curve, which was regular. The method of observation for clock-error was that described in last year's report, Appendix No. 3; the increase in accuracy over previous years was in the neighbourhood of 50 per cent. There were 156 exchanges for longitude, occupying 116 nights; exchanges were had irrespective of the weather at Ottawa, the clock error being when necessary interpolated from adjacent nights. An analysis was made of the rate of the Sidereal Standard as shown by the observations; the probable variation of daily rate appears to be between .01 sec. and .02 sec. per day; the advantage of having a completely uniform temperature is markedly shown. An approximate investigation was made, by observations suited to the purpose, of the causes underlying personal equation in micrometer observations. Mr. Stewart found in his own case a tendency to set the movable wire always to the same side (the left) of the star, by a quantity in the neighbourhood of a second of arc, depending on the magnitude of the star; north stars at upper culmination would thus be observed too soon, others too late. This affects the observed clock-error, and more markedly the azimuth. It was found that this would approximately explain the difference in personal equation of two of the observers, but not completely that of the third.

MERIDIAN CIRCLE.

The piers in the meridian circle room and the transit room have been rebuilt, their bases being sunk deeper into the earth and a system of drainage into a specially prepared cistern being installed, the cistern being pumped out from time to time. During wet periods there has proved to be a great accumulation of water in the cistern;

though the latter holds in the neighbourhood of 1,200 gallons it has on a number of occasions been filled to overflowing in a single night, apparently by surface water entering under the foundation walls of the building. This is very undesirable, as in that case the water becomes backed up around the footings of the piers. The only remedy would seem to be a proper drain surrounding the outside walls to carry off the surface water.

Provision has been made in the collimator piers for underground lenses to serve as permanent marks, over which may be adjusted the long-focuss collimating lenses for the azimuth marks; pits have also been provided to allow access to the underground marks. The positions for the azimuth marks have been accurately determined and marked.

The mechanism for opening the roof shutters has been installed and works satisfactorily; the iron wall shutters have been replaced by wooden ones; wire frames have been made for the louvres in the walls to exclude snow, and have been in place during the past winter; the piers have been encased in felt and wood, with an air-space, to avoid sudden changes in temperature; an extension was made to the main instrument pier to provide for observations by reflection.

The meridian circle itself was in the beginning very unsatisfactory in almost all respects. When the graduated circles were received from the makers after having been repaired it was found that owing to irregularities in the bearings on axis and circles, the plane of the graduations was not perpendicular to the axis, nor was the distance from graduations to end of axis the same for both circles. While the adjustment of these errors was in progress it was found that the pivots were soft; it was therefore necessary to turn down the pivots and fasten upon them hardened steel bushings. Owing to the lack of lathes and grinders of the size requisite to handle the axis this proved a most arduous undertaking, but has at length been successfully accomplished. In this connection I wish to express my appreciation of the very great kindness of Mr. A. H. W. Cleave, of the Royal Mint, who was good enough to offer us the use of his workshop and even to have alterations made in his machines which made it possible to handle the work. Had it not been for his kindness the work could hardly have been done in Canada. There is still a great deal of work to be done on the instrument before it will be in a condition to do effective work. The counterpoises are unsatisfactory, and will require to be replaced by new ones; the bearings of the vertical circle require to be scraped and polished; alterations are necessary in the micrometers of the circle microscopes; the double spider lines in right ascension and declination micrometers and circle microscopes are at unsuitable and varying distances; in addition there is a multitude of small details that require alterations. When these have all been completed, however, the instrument will probably do efficient work. It is hoped that it may be ready for systematic work in both right ascension and declination by the beginning of the year.

For further details reference may be had to Mr. R. M. Stewart's report, in Appendix No. 3.

#### WORK OF THE ASTROPHYSICAL DIVISION.

The principal work in this division has been observation by the spectroscope of the radial velocities of spectroscopic binaries for the determination of the elements of their orbits. Five orbits have been thus determined:  $\eta$  Bootis,  $\theta$  Aquilæ,  $\alpha$  Coronæ Borealis,  $\epsilon$  Herculis,  $\beta$  Orionis. In only the first of these have the observations been well satisfied by a velocity curve due to simple elliptic orbits. In two of the others irregularities show which are explained fairly well on the hypothesis of the presence of a third body. Four stars with early type spectra  $\delta$  Herculis,  $\gamma$  Aquarii,  $\iota$  Andromedæ, and  $\xi$  Persei, have been examined and their velocities found to be variable, but not enough observations have been made to determine the law of variation. Twelve other binary systems are under observation.

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Considerable time has been spent in testing and adjusting the instruments and in experimenting on the best methods of observation. Mr. Plaskett investigated the fields given by different types of camera objectives for spectrographs, and the effect of increased slit width upon the accuracy of radial velocity work. Dr. DeLury examined the errors of the plane grating of the spectrograph of the cocostat. Mr. Motherwell investigated the aberration of the eight-inch doublet of the stellar camera, and proved that the halos which the lens gives around the images of stars are due to spherical aberration, which may be corrected by slight refiguring of the lens.

Other work in this division has been micrometric measurements of double stars, comet photographs, observations of occultations of stars, and solar photography. This work as well as all the other astronomical work has greatly suffered from the dense smoke from forest fires which prevailed during a great part of last summer.

Fuller details of this work will be found in Mr. Plaskett's report, Appendix No. 2.

## DIVISION OF GEOPHYSICS.

Continuous records have been obtained by the Bosch seismograph of earth movements. Some forty-nine earthquakes were recorded during the twelve months from April 1, 1908, to April 1, 1909, including five of some severity. Ordinarily the record of an earthquake shows that waves of three kinds are received. These are called the first preliminary, the second preliminary, and the long waves. They are distinguished from one another on the seismograph sheet by differences in form and amplitude, and the times of first arrival of the waves of each type may be measured off from the sheet very nearly.

It is supposed that the three waves have their origin at the same instant of time at the centre of disturbance, and that the difference in time of arrival is due to a difference in the mode of transmission through the earth's crust, whether by longitudinal or transverse vibrations through the depths of the earth, or near the surface, and that corresponding to the different modes or paths of transmission are different but definite velocities.

These velocities have been found by many observations within pretty close limits. Hence the difference of time between the first arrival of the different waves gives immediately the distance of the origin of disturbance. The actual position of the origin may often be determined by drawing a circle on a terrestrial globe with centre at the place of observation and radius equal to the distance of the origin. Where this circle passes through a region of known seismic activity, the probable origin of the disturbance may be placed.

Besides the records of earthquakes, numerous minor tremors, called microseisms, have been registered. An account of these, with an inquiry into their probable causes will be found in the report of Dr. Klotz, which forms Appendix No. 1 to this report.

Dr. Klotz concludes that the microseismic vibrations of the pendulums of the seismograph are closely connected with the gradients of barometric pressure, and that their amplitudes increase with the steepness of the gradient.

Microseisms are not due to the dynamical effect of the movement across the continent of areas of high or low pressure, nor to the direct dynamical effect of winds.

Microseisms registered at Ottawa almost invariably co-exist with 'lows' over the Gulf of St. Lawrence with steep gradients over the St. Lawrence valley.

They arise from movements of large areas of the earth's crust, and are related to the geological structure by which probably their period is determined.

The meteorological conditions on which they appear to depend are not local; the variations of local barometric pressure shown by the micro-barograph cause local bendings of the earth's crust which are exhibited on the seismograms by deflection of the zero of the instrument, but the irregularities thus caused are easily distinguished by their irregularity from the real microseisms.

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It has been suggested that the fact that the period of most of the microseisms nearly agrees with that of the pendulums, indicates that the record is due to air currents within the instrument or to other instrumental cause. This explanation, however, cannot stand, in view of the evidence adduced by Dr. Klotz, of co-incident occurrence with the 'lows' on the eastern coast.

#### AUXILIARY BUILDINGS OF THE OBSERVATORY.

During the past year the coelostat house has been completed, and the coelostat installed, with its spectrograph. As stated above a careful examination has been made of the plane grating of this instrument, by which certain defects have been indicated. The making of this necessary examination has delayed the making of the observations on the sun which were contemplated.

The building for the standardizing of tapes and other measures of length has been completed, but the apparatus for making comparisons has not yet been installed. Means will be provided for tests of measures up to 50 metres in length.

Ground was broken for the residence of the Chief Astronomer about the middle of March last. This building will stand a short distance to the east of the Observatory.

Work was begun last summer on the grading of the grounds surrounding the Observatory, a much needed improvement. Owing to the excessive dryness of the latter part of the summer it was not thought advisable to do any sodding, which has been postponed until this season.

#### FIELD ASTRONOMICAL WORK.

Latitudes and longitudes were determined at twenty-seven stations during the season of 1908.

Two stations on the southern boundary of British Columbia, one near the southern boundary of Manitoba in the neighbourhood of Lake of the Woods, and three on the Ontario-Minnesota border, were observed for purposes of the boundary surveys. The other points were observed for geographical purposes, and comprise three points in Ontario, eight in Quebec, eight in New Brunswick, and two in Nova Scotia. The longitudes of the two most westerly stations were determined by telegraphic signals from Seattle, a point of known longitude; that of the others by signals from this Observatory.

Observations of the magnetic elements were made at seventeen points in British Columbia and at Winnipeg, Ottawa and Agincourt. The instruments used were the Tesdorpf magnetometer and the Dover dip-circle.

#### INTERNATIONAL BOUNDARY SURVEYS.

On June 3, 1908, a treaty between His Majesty and the United States was ratified, which provides for the survey of the whole of the boundary line from the Atlantic to the Pacific.

The treaty divides the boundary line into eight sections, and prescribes the manner in which the survey of each section shall be carried out, and placed the carrying out of the work, except as regards the fourth section, in the hands of two commissioners who shall be 'expert geographers or surveyors.'

The several sections are as follows:—

1. In Passamaquoddy bay, from the open waters of the Bay of Fundy to the mouth of St. Croix river (at Joe's Point near St. Andrews, N.B.).

By the treaty of 1783, the boundaries of the United States were defined as beginning at the mouth of St. Croix river and ascending that river to its source. Then the description proceeds with the northeastern, northern, western and southern boundaries of the United States, terminating on the Atlantic ocean at the northern

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boundary of Florida. The territory of the United States was also to include 'all the islands within twenty leagues of the coast except such as have heretofore belonged to His Majesty's province of Nova Scotia.' ('Nova Scotia' then included the present province of New Brunswick.)

Soon afterwards question arose as to which river was the St. Croix, mentioned in the treaty; it appears that three or more rivers bore that name. Commissioners were appointed under a special provision by treaty (1794) to decide which river was intended and to determine its mouth and its source.

The Commissioners in due course reported (1798) their decision identifying the St. Croix river of the treaty with the river which now bears the name, and placed its mouth opposite Joe's Point, the point at the southwestern extremity of St Andrews peninsula, opposite to the town of Robbinston, in Maine.

South and east of this point lies Passamaquoddy bay, being the western part of the Bay of Fundy, and including an extensive archipelago.

It will be observed that the decision of the Commissioners, placing the mouth of St. Croix river at Joe's Point, left the jurisdiction over the islands of this archipelago, which are within twenty leagues of the United States shores, to be determined by the fact whether they had previously belonged to the United States or to Nova Scotia.

Under the fourth article of the treaty of Ghent, 1814, Commissioners were appointed to determine to which of the High Contracting Parties the several islands belonged. These Commissioners rendered their decision in 1817 to the effect that Moose, Dudley and Frederick islands belonged to the United States, and that all the other islands in Passamaquoddy bay, and the island of Grand Manan, in the Bay of Fundy, belonged to His Britannic Majesty. This decision, however, did not determine the locality of the boundary line in the narrow waters between Campobello island and the islands allotted to the United States, and subsequently difficulties arose in regard both to smuggling and to fishery rights.

It was not until 1892 that provision was made by treaty for the determination of the boundary line in these waters, and commissioners were appointed to determine and mark the line.

This the Commissioners did in part but not wholly, since they failed to agree as regards the ownership of a certain island and of certain fishing grounds.

By the treaty of 1908, provision was made for the preparation on the behalf of each government of a 'case' to be submitted to the other, and in the event of their not arriving at an agreement within one year of the date of ratification of the treaty, for a reference of the question to arbitration. The cases of the two governments were duly presented on December 3 last, six months after ratification of the treaty.

These negotiations, or the arbitration which will result, if they do not result in an agreement, have reference only to the two specific points on which the Commissioners of 1892 differed. Their marking of other parts of the line is confirmed by the treaty. The present Commissioners are to renew the marks when necessary, and to lay out the remainder of the line when a decision of the disputed questions has been arrived at. Pending such decision no work has yet been done on this section.

2. The second section of the line is that along St. Croix river from its mouth to its source.

As already stated the Commissioners of 1798 determined the source of this river as well as its mouth. This was sufficient to obviate disputes involving any large extent of territory, and no serious question is known ever to have risen. For this reason doubtless no survey of the river as an international boundary has been made, or indeed provided for, by any previous treaty. In its course the river expands into several large lakes in which as well as in the river itself islands exist, which may become of importance in the future. The treaty provides that the boundary line shall follow the thalweg, or middle of the main channel as naturally existing, except where such would conflict with the recognized national character of an island. The boundary line is to

be marked where possible by permanent monuments, and is to be shown by the Commissioners on accurate modern charts. Like provisions apply to all the sections of the boundary line.

It is proposed to send out two survey parties, an American and a Canadian party this summer to make the preliminary survey necessary for the setting out of the permanent reference marks. They will operate in the navigable part of the river below the international bridge connecting St. Stephen and Calais.

3. The third section extends from the source of the St. Croix to the St. Lawrence river. An approximate description of this section of the boundary line is: along the meridian of the source of St. Croix river to St. John river, up the latter and one of its branches, St. Francis river, to a certain point; in a straight line to the south-west branch of St. John river; up the last to its source in the highlands (of the St. Lawrence); along the highlands to the source of Hall's stream (a branch of Connecticut river); down the last to the 45th parallel; and along the 45th parallel to the St. Lawrence.

By the treaty of 1783, the boundary line was to follow the due north line from the source of St. Croix river to the highlands dividing the waters flowing into the St. Lawrence from those flowing into the Atlantic ocean, and thence to follow the highlands to the source of Connecticut river; and follow the river to the 45th parallel, and the parallel as far as the St. Lawrence.

Dispute arising as to the location of these highlands, this section of the boundary line remained undetermined for many years, the question about the year 1840 assuming a very serious phase, though more than one attempt had previously been made to settle it. By the treaty of 1842 the matter was finally disposed of, the definition adopted for the boundary, being a compromise between widely differing claims. The line was surveyed and marked with cast-iron monuments in the years 1843 to 1846, by a joint Commission.

For brevity in the above description of the boundary line, I have spoken of the meridian line of the source of the St. Croix and of the 45th parallel. The boundary line does not accurately follow these astronomical lines, but follows the lines of old surveys, originally intended to coincide with them, but which show in places very large deviations from them. The perpetuating in this manner of the errors of the old surveys was dictated by reasons of convenience arising out of the fact that in many instances the country had been settled on either side up to the old survey, and the lands were in private hands.

As a result of complaints which had from time to time been received, that some of the original monuments had been destroyed and that there was difficulty in places in finding the line, in 1890 an inspection, jointly with representatives of the state of New York was made of the line from Richelieu river to the St. Lawrence. This inspection indicated that it was necessary to renew the original monuments, as well as to place new ones where the line had been in the first instance insufficiently marked.

Nothing, however, was done until 1902, when an agreement for co-operation in the work of renewal was made with the government of the state of New York with the concurrence of the Washington government and a joint re-survey of the line was made, and new monuments of granite were erected.

In 1906 an agreement was made with the United States government for a joint re-survey of the rest of the line from Richelieu river to the St. Croix, and the work has since been actively prosecuted. The re-survey and renewal of monuments has been completed from Richelieu river to Hall's stream (covering the northern boundary of the state of Vermont) and along the meridian of the St. Croix river to the St. John. This has been done by a joint survey party representing both governments. The work so done will of course be available for the use of the Commissioners appointed under the new treaty.

It is proposed this year to proceed with the survey along the River St. John.

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4. The fourth section covers the River St. Lawrence, the Great Lakes and their connecting waters, from the intersection of the 45th parallel by the River St. Lawrence to the mouth of Pigeon river in Lake Superior.

A general and rather vague description of this part of the line was contained in the treaty of 1783. The sixth article of the treaty of Ghent, 1814, provided for the appointment of Commissioners to determine the actual course of the line through the rivers and lakes, from the initial point in the St. Lawrence as far as the water communication between Lake Huron and Lake Superior. The seventh article of the treaty provided that the same Commissioners should determine the line from the said water communication to the North West Angle of the Lake of the Woods.

The Commissioners made the necessary surveys and laid down the line on their maps, reporting in 1822 their agreement so far as their work under the sixth article of the treaty was concerned. They, however, were unable to come to a full agreement under the seventh article, and that part of the line remained undetermined until settled by the treaty of 1842.

Owing to the imperfections of the maps upon which the Commissioners under the treaty of Ghent drew their line, difficulty is found in accurately transferring it to modern charts. The present treaty provides for the ascertainment and accurate re-establishment of the line, for the laying of it down on modern charts, and for the marking so far as practicable of the course of the line by buoys, monuments and range marks.

The carrying out of these provisions with respect to the fourth section of the boundary line is placed in the hands of the International Waterways Commission, which is composed of three Commissioners on the part of the Dominion of Canada and three Commissioners on the part of the United States.

5. The fifth section extends from the mouth of Pigeon river, up that river and through various lakes and rivers to the North West Angle of the Lake of the Woods.

The North West Angle of the Lake of the Woods was one of the governing points in the description of the boundaries of the United States in the treaty of 1783. Its location was ascertained without difficulty, but from the want of good maps when the treaty of 1783 was framed the line between the Lake of the Woods and Lake Superior was so vaguely defined as to leave room for widely different interpretations. Thus one contention was that the boundary line should ascend the St. Louis river at the head of Lake Superior, where Duluth now stands; another, that it should ascend the Kaministikwia. The Commissioners under the treaty of Ghent narrowed the question down to a choice between two water routes, both leading from Pigeon river to Rainy lake, and thence by Rainy river to Lake of the Woods. These two routes diverged a short distance up Pigeon river, passing one north and the other south of a considerable area almost surrounded by a series of lakes and rivers, now known as Hunter's island. By the treaty of 1842 the southern route was adopted.

No survey of the international boundary has been made along this section of the line. The Commissioners under the treaty of Ghent prepared maps to illustrate their report, but their surveys were imperfect.

The Commissioners under the present treaty having the duty of exhibiting the boundary line on modern charts will have to make a topographical survey over the whole distance.

6. From the North West Angle of the Lake of the Woods to the Rocky Mountains.

The treaty of 1783 described the northern boundary of the United States after reaching the North West Angle as proceeding thence west along the 49th parallel of north latitude to the Mississippi river.

It was afterwards ascertained, however, that the North West Angle lay about twenty-five miles north of the 49th parallel, and that the Mississippi river did not extend so far north as the parallel by a considerably greater distance.

The treaty of 1818 provided that the boundary line should follow the 49th parallel west to the Rocky Mountains. To provide for the difficulty as to the latitude of the North West Angle, it was agreed that the boundary line should be drawn due south from the angle of the lake to the 49th parallel. Thus occurred the peculiar 'jog' which the maps show in the boundary line at Lake of the Woods.

An interesting point in this connection is that the Commissioners who surveyed the meridian south from the North West Angle in 1872 found that their line starting from the old monument marking the North West Angle crossed the line of boundary which had been drawn by the Commissioners under the treaty of Ghent along the inlet of the lake at the head of which the monument stands.

This meridian line and the 49th parallel west as far as the Rocky Mountains were surveyed by a joint Commission in the years 1872 to 1874. The line was marked by iron posts one mile apart so far as the old boundary of the province of Manitoba extended (from longitude 96° to longitude 99°). On the remainder of the line the monuments were farther apart, averaging about three miles, and consisted of large mounds of earth or stones.

The re-survey of the line has the purpose of re-locating and repairing lost or damaged monuments, and establishing additional monuments wherever necessary to meet the requirements of modern conditions.

The doing of this was provided for in an administrative agreement between the governments, entered into in 1902. This agreement provided for a survey of the whole line from Lake Superior to the Gulf of Georgia, on the Pacific coast, but the completion of the portion west of the Rocky Mountains being more immediately pressing, operations were begun at that end, and the section east of the Rocky Mountains was not reached until last year. A Canadian party under Mr. J. J. McArthur began operations at Coutts, Alberta, which lies about one hundred miles east of the Rocky Mountains. The operations of the survey during the season covered one hundred miles east from Coutts, the section west of that place being left to an American party, under an agreement between the Commissioners by which the line was divided into alternate sections of one hundred miles.

#### 7. From the Rocky Mountains to the Gulf of Georgia.

By the treaty of 1846, the boundary line here also lies on the 49th parallel. It was surveyed and monumented by a joint Commission in the years 1859 to 1863. The monuments generally consisted of mounds of stones, though along a certain part of the line cast-iron monuments were placed. Owing to the exceedingly mountainous character of the country the survey was not a continuous one; the position of the parallel was determined by astronomical observation in some of the principal valleys, and the line was cut out east and west from the astronomical stations as far as possible in the circumstances.

The survey made under the agreement of 1902 is continuous, from the summit of the mountains to Point Roberts in the Gulf of Georgia. Monuments of aluminum bronze, set in concrete bases, have been placed at average distances of two miles along the whole length of the line, and a wide vista has been cut through the forest from monument to monument. The field work was completed in 1907, with the exception of a short piece of triangulation in the Cascade Mountains, which was finished last year. The plans and other records of the survey have yet to be put into final shape for publication.

8. The eighth section is the water boundary from the 49th parallel to the Pacific ocean.

By the treaty of 1846 the boundary line was to follow the 49th parallel to the middle of the strait between Vancouver island and the mainland, and of the strait of Fuca to the Pacific ocean.



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East of the southern extremity of Vancouver island and lying between it and the mainland lies an archipelago of considerable extent. Not many years after the treaty of 1846 the question arose to which country these islands belonged.

The principal island in the group is the island of San Juan, and the question which arose is commonly referred to as the San Juan question. The group is separated from Vancouver island and the islands adjacent thereto by Haro strait, and is separated from the Washington shore and its adjacent islands by Rosario strait. Both countries claimed ownership of the group of islands between these straits and for several years there was joint occupation of San Juan island by military forces.

By the treaty of Washington, 1871, it was agreed to refer the question to the decision of the Emperor of Germany, who decided in favour of the United States, that the boundary line should follow Haro strait.

In 1873 at a conference held at Washington by representatives of both countries an agreement was reached as to the actual course of the line, in accordance with the Emperor's decision, and the boundary line was defined by a line drawn upon a chart, accompanied by a written description.

The present treaty in providing for the survey of this line follows accurately the wording of the protocol of the conference of 1873, excepting at one point only, where a short curved line is replaced by a straight line.

It is proposed during the present season to send two survey parties to make the necessary surveys for the placing of reference monuments to perpetuate the points named in the treaty.

Mr. O. H. Tittmann, Superintendent of the United States Coast and Geodetic Survey, and the writer were appointed in June last commissioners, representing respectively the United States and His Majesty, for the carrying out of this treaty (excepting as regards the fourth section of the line).

*Canada-Alaska Boundary Line*

This boundary is in two sections, the most northerly following the 141st meridian of west longitude from a point near the summit of Mt. St. Elias to the Arctic ocean, the other starting from Cape Muzon on Prince of Wales island in about latitude  $54^{\circ} 40'$ , crossing the sea to the entrance of Portland channel, ascending the channel to a certain point, and then following certain mountains.

This boundary was first defined by the treaty of 1825, between Great Britain and Russia. The treaty described the line from its point of commencement, the southernmost point of Prince of Wales island, up Portland canal, and thence in a direction generally parallel to the coast to the 141st meridian of longitude west from Greenwich; thence along that meridian to the Arctic ocean. This definition of the boundary was of course not affected by the transfer of Alaska to the United States in 1867.

No demarcation had been attempted during the Russian occupation, but a few years after the transfer attention became directed to the boundary question. It was seen that the interpretation of the treaty as regards the southern part of the boundary, from Prince of Wales island to the 141st meridian, presented great difficulties, while the description of the remaining portion, following a definite astronomical line, the 141st meridian, was clear and unambiguous, and has never been the subject of controversy.

Hence in subsequent discussions the boundary line has been divided into two parts, which have been dealt with separately.

It is not my intention here to go into detail concerning the points of the controversy over the line from Prince of Wales to the 141st meridian. In 1892 a treaty was entered into between Great Britain and the United States, the first article of which provided for the appointment of commissioners to make a survey of the region

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adjacent to the line with a view to the ascertainment of the facts and data necessary for the permanent delimitation of the line in accordance with the spirit and intent of the then existing treaties.

The Commissioners made extensive topographical surveys of the mountains adjacent to the coast, and rendered a joint report to the two governments on December 31, 1895.

Although the treaty provided for the consideration of the boundary question, as soon as the report of the Commissioners had been received, the matter was not taken up until three years later, when it was discussed by the Joint High Commission, but without any action being determined upon.

In 1903, by treaty, the matter was referred in the form of five questions to a tribunal of six jurists, who held their sittings in London in September and October, 1903.

By their decision the line was to be drawn from Cape Mazon, on Prince of Wales island, in a straight line to a certain point off the mouth of Portland canal; up the canal to a certain point; then following certain mountain summits (which they marked out on the maps prepared by the survey made under the treaty of 1892) to Mt. St. Elias, which is near the 141st meridian.

The series of mountain summits selected by the tribunal was incomplete, in that between a certain summit north of Frederick sound and another north of Taku inlet a gap was left, some 120 miles in extent. In this gap the tribunal found the available topographical information not sufficiently complete to enable them to decide which were the mountains referred to in the treaty of 1825, and the line as regards that portion was left undetermined.

In the following year a conference between the Commissioners charged with the duty of the demarcation was held, at which a recommendation was made as to the course which the line should follow across the gap, and in March, 1905, this recommendation was formally approved by both governments.

By this agreement the line follows southward from the peak north of Taku inlet, from summit to summit of seven intervisible mountains, till a point near Whiting river is reached. Another peak was selected near the southern end of the gap. These eight peaks lie nearly in a straight line between the two terminal peaks of the Award. Between the seventh and eighth of them a gap remains about 50 miles in length in which the agreement leaves the selection of peaks in the hands of the Commissioners, after necessary surveys are made, the peaks selected to be intervisible and none of them more than 2,500 metres distant from the straight line joining the terminal peaks.

#### *Survey of the Boundary of the Coast Strip of Alaska.*

The demarcation of the Award line was begun in 1904 and has been continued since as rapidly as possible.

The work of the season of 1908 comprised the marking of the line at Alsek river, on the southern branch of the Iskut river (a tributary of the Stikine) and on the Unuk river and its tributaries, besides the topographical survey necessary for the carrying out of the agreement of 1905.

The Iskut work was carried on by Mr. J. D. Craig, D.L.S., and that of the topographical survey by Mr. W. F. Ratz, D.L.S., while Mr. White-Fraser, D.T.S., and Mr. F. H. Mackie, D.L.S., worked on the Alsek and Unuk rivers respectively, in conjunction with American parties.

The topographical survey of the region between the peak above referred to near Whiting river and the mountains north of Frederick sound was begun by Mr Ratz in 1907, and completed by him last year, so that the Commissioners have been able to

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make a selection of summits which accord with the conditions of the agreement of 1905, and it is hoped that the demarcation of this part of the line will be completed during the coming summer.

When this has been done little of the boundary of the coast strip of Alaska will be left for demarcation except a fifty-mile stretch near Mt. St. Elias and two or three uncompleted portions of a few miles each.

I regret to have to record the death of Mr. Ratz which occurred in Ottawa on February 6. Mr. Ratz had been employed on the Alaska survey since 1905. He carried out the demarcation of the line at Salmon river (Chilkat district), and in part between Taku inlet and Whiting river. During the last two years he was engaged, as already stated, on the topographical survey between Whiting and Stikine rivers, not the least difficult section of a very difficult survey. His success in carrying this to completion in a relatively short time is a testimony of his capability as a surveyor as well as to his personal energy. His death, at the early age of 25, is a serious loss to the profession and to the public service.

*Survey of the 141st Meridian.*

This survey and demarcation is carried on in pursuance of the treaty of 1906.

This treaty does not alter in any way the boundary line as defined by the treaty of 1825, but provides for the manner of making the survey and the demarcation merely.

Operations were begun in 1906 by ascertaining the position of the meridian at the crossing of the Yukon river by astronomical observations for longitude, using the telegraph for comparison of time.

The survey of the line south from the Yukon crossing was begun in 1907, and in 1908 continued southward to a point south of White river, a distance from the Yukon crossing of 225 miles. The placing of the permanent monuments on the line made good progress, as also the triangulation and topographical survey which is being made along the line.

Mr. A. J. Brabazon, D.L.S., was in charge of the Canadian parties engaged in this work.

## THE GEODETIC SURVEY OF CANADA.

The work accomplished by the Geodetic Survey staff during the season of 1908 is briefly as follows:—

Two observing parties, measuring horizontal angles, were in the field during the whole season, but on account of the prevalence of dense smoke very little work was accomplished. The district covered lies between Brockville and Toronto.

Reconnaissance surveys were conducted in the maritime provinces, in the province of Quebec, in western Ontario and along the international boundary west of Lake Superior. This latter reconnaissance was for the purpose of making a primary triangulation to control the survey of the international boundary along Pigeon river. The reconnaissance in the province of Quebec, which embraced all of that part of the province lying southeast of the St. Lawrence river from Montreal to a point some thirty miles below the city of Quebec, and also one row of triangulation stations to the northwest of the St. Lawrence river a sufficient distance back therefrom to secure high enough points to control the country to the southeast was most gratifying in its results; it was successful in securing an excellent system of quadrilaterals and large five and six sided figures with central points.

The work of signal building was continued west of Toronto as far as Woodstock or thereabouts. In the maritime provinces reconnaissance has been satisfactory. The stations for a triangulation extend from Chamcook mountain in the southwest corner

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at New Brunswick, to the northerly extremity of Cape Breton island, embracing a district about fifty miles wide between those points, including the easterly portion of Prince Edward island. Chamecock mountain is one of the primary triangulation stations of the United States Coast and Geodetic Survey and in conjunction with Trescott Rock—another primary station of the same survey—direct connection is made with the Geodetic Survey of the United States.

In 1908 two Geodetic levelling parties were employed and a line of levels was carried from Coteau Junction—thirty-eight miles southwest of Montreal—to Fort Erie via Hamilton, and also from Hamilton to London. The computations are now in progress and are sufficiently advanced to show that the results are of a high order of precision. The work has been carried on by a double line of levels running forward and backward directions, the forward and backward levelling being independent of each other in every respect, and when possible, performed under different atmospheric conditions. The standard of accuracy adopted requires that the backward levelling shall correspond with the forward levelling within  $0.017 \sqrt{M}$ , 'M' being the distance in miles covered by the section. The dense smoke, so prevalent during the season of 1908 and which interfered so materially with the trigonometrical work, was found to be an assistance in precise levelling, inasmuch as the usual steadiness of the atmosphere—no doubt caused by smoke—made the observing of the graduations on the levelling rod much easier than in former seasons.

Consequent upon a discussion in parliament, in which was apparent a concurrence of opinion that an accurate survey of the better settled parts of Canada would be of practical benefit, the government, by order in council of April 20 last, formally instituted the 'Geodetic Survey of Canada,' and appointed the writer superintendent.

The following appendices are attached to this report:—

- Appendix 1.—Report by Otto Klotz, LL.D., on seismological and magnetic work.
- Appendix 2.—Report by J. S. Plaskett, B.A., on the astrophysical work.
- Appendix 3.—Report by R. M. Stewart, M.A., on meridian work and time service.
- Appendix 4.—Report on observations for latitude and longitude by J. Macara.

I have the honour to be, sir,

Your obedient servant,

W. F. KING,  
*Chief Astronomer and Boundary Commissioner.*

**APPENDIX 1.**

REPORT OF THE CHIEF ASTRONOMER, 1909.

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**SEISMOLOGY, TERRESTRIAL MAGNETISM AND  
GRAVITY**

BY

OTTO KLOTZ, LL.D.



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## APPENDIX I.

## SEISMOLOGY, TERRESTRIAL MAGNETISM AND GRAVITY, BY OTTO KLOTZ, LL.D.

OTTAWA, ONT., July 1, 1909.

W. F. KING, LL.D., C.M.G.,  
 Chief Astronomer,  
 Department of the Interior,  
 Ottawa.

SIR,—I have the honour to make the following report of the work carried out under my charge, and which is classified under the three headings—Seismology, Terrestrial Magnetism and Gravity.

## SEISMOLOGY.

*Instruments.*—The instruments which are in service are: two Bosch photographic seismographs, described in the report for 1906; a Callendar electric recorder; a Negretti and Zambra barograph; a Shaw-Dines micro-barograph, besides wet and dry bulb thermometers.

The Callendar electric recorder is from the Cambridge Scientific Instrument Company, England. It was installed in August 10, 1908, and has given satisfaction. It records the outside temperature. It is similar to the one used in connection with our standard sidereal Riefler clock for temperature control. In the report for 1907 Mr. R. M. Stewart gives an illustration of the recorder, together with a detailed description, so it is unnecessary to describe the other one. It may be mentioned, however, that the extreme possible range of outside temperature is confined within the range of the galvanometer wire along which the sliding contact balances the resistance of the platinum wire thermometer, wound on a mica frame. The thermometer is housed in a louvered shelter 2 feet 6 inches by 1 foot 8 inches and 2 feet 6 inches high with slanting double top, the whole being painted white; it is mounted on four posts and the bottom is 4 feet above the ground in an open space with free circulation of air. It is 46 feet from the northwest corner of the transit house of the observatory. The lead-covered double leads are led from the thermometer in an iron 3-inch pipe under ground, then through the wall of the Observatory and finally into my room to the recorder. The range of resistance on the galvanometer wire and covering the sheet which is daily renewed, is equivalent to 100°, that is, the readings extend from - 50°C. to + 50°C. or from - 58°F. to + 122°F., and this is represented in linear measure on the sheet by 20 cm., so that 1°C. is equivalent to 2mm. The temperature records are very satisfactory, and the rapid oscillations of temperature on bright cloudless days is very marked. These fluctuations amount to several degrees within a few minutes, showing that the atmosphere is far from being homogeneous as far as temperature is concerned, but instead is permeated by thermal and density 'schlieren,' continuously shifting. The scale of the bridge-wire was determined by readings of several standard mercurial thermometers placed within the thermometer shelter.

Last March another platinum wire thermometer was installed; it is in the well at the bottom of the south collimator pier of the meridian circle. The leads of this

thermometer are led to a special switch beside the recorder, and every morning before taking off the sheet a reading is taken of this latter thermometer, which is subject, of course, to a very slow change of temperature.

Of the aneroid barograph with its weekly recording sheet nothing further need be said. Beside it hangs the Greene standard mercurial barometer and by which the readings of the former are checked.

In connection with the study of the seismograms, especially of the microseisms and other records, such as movements of the position of the pendulum zero not attributable to earthquakes, a Shaw-Dines micro-barograph was installed last July (1908), also a Richard Frères statoscope. Although the latter works very well, its time-scale is too large (one revolution of the cylinder in less than an hour) for continuous use. The former is an apparatus designed to magnify and record the minor and sudden fluctuations of the atmosphere as opposed to the general atmospheric surges. It records the small variations on a scale magnified twenty fold, the general surges being practically obliterated through the operation of a small leak. It thus records comparatively rapid oscillations, and no others. The instrument consists of a small, closed vessel containing air, which communicates with a mahogany box containing mercury, on the surface of which floats, mouth downwards, a light hollow cylindrical bell. The air is enclosed in a large japanned metal chamber, the space between the two being filled with a non-conducting material. The movements of the bell are transmitted to the chart by means of a delicate system of leverage. The chart is wound round a drum actuated by clock-work, and making one revolution in twenty-four hours.

This instrument (micro-barograph) has given efficient service for the purpose for which it was desired, viz., in the first place to give a record of very rapid barometric fluctuations with the accompanying gusty winds, and secondly to enable one to make a comparison of such record with the seismogram to determine the relationship, if any, between the micro-barogram and seismogram. This has now been clearly and unequivocally established by simple ocular demonstrations. Whenever a closely serrated line with amplitudes of a sixteenth to quarter of an inch (about the maximum for very rapid oscillations) is found on the micro-barogram, the seismogram will show for the same time invariably an irregular record, not microseisms, which appear as a combination of tilting and horizontal movements, probably vertical movements too. They can never be mistaken for any phase of earthquake effects nor for microseisms, about which more will be said hereafter. The service of this instrument has been wholly confined to interpretation of some of the disturbances recorded by the seismograph and not for other meteorological purposes, as that is outside of our field.

The electric light 16 c.p., 104 v., continues to serve for the seismograph, and is efficient although slightly reduced in brightness when the machinery using the motor, and the lights of the observatory are on. A 'detector' was installed in my room, on the wall opposite to my desk. The object is to show when, by accident, the filament of the seismograph lamp should break, or otherwise the light circuit be interrupted. This is effected by having two small 1-candle power lamps in series, with the main lamp in the basement, and being themselves in parallel. The idea of having the two small lamps in parallel is that if one of them should give out, the circuit would not be interrupted, but would show by the other small lamp burning much brighter. The scheme works very well.

In last year's report I spoke of the trouble that some of the electric lamps, necessarily with single filament, gave by the vibrations set up in the filament and produced by the electric current alone. This has been nearly eliminated by the use of new lamps with shorter filaments. Occasionally spots of a widened line are shown on the seismogram when the filament has oscillated for a few seconds. It is a rather peculiar phenomenon and was discussed in detail last year.

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The two horizontal pendulums have remained in their respective positions N.-S. and E.-W. during the year. The steel point of the N.-S. pendulum bearing against the lower support was found to have become somewhat blunted, so it was replaced by a spare point supplied by Bosch when the instrument was purchased. The effect of this was well shown in the record of microseisms whose amplitude although always small was distinctly increased by the decrease of friction at the point of lower support. For this same pendulum, as noted last year, the air-damping had been replaced by oil-damping, in the belief that the oil would be very much more efficient for the purpose of damping. Neither the damping by the oil nor the surface tension manifested themselves as conspicuously as anticipated. The experimental test was made with an immersion of 3mm. by the aluminum vane of the aluminum rod which extends from the 'bob,' or mass. The damping co-efficient was practically the same as with the air damping. The oil used was ordinary bicycle oil with some clock oil.

As in previous years a record has been kept of the hygrometric condition immediately without and within the seismograph room. The humidity although subject to small oscillations is in general dependent upon the season and the artificial heating of the building during the colder months. The least humidity is during the winter, and the greatest during the summer, ranging from an average of 36 per cent in January to 75 per cent in July. Since the construction of an additional drain below the seismograph cement floor there has been no occasion to use chloride of calcium for the absorption of moisture. The following are the bi-monthly means:—

| Months.            | Humidity. |                   | Months.              | Humidity. |                   |
|--------------------|-----------|-------------------|----------------------|-----------|-------------------|
|                    | Basement. | Seismograph Room. |                      | Basement. | Seismograph Room. |
| 1908               |           |                   |                      |           |                   |
| April 1 to 15..... | 48.6      | 45.7              | October 1 to 15..... | 61.7      | 57.9              |
| " 16 to end.....   | 49.2      | 47.2              | " 16 to end.....     | 72.2      | 54.7              |
| May 1 to 15.....   | 58.7      | 60.7              | November 1 to 15.... | 81.3      | 48.2              |
| " 16 to end.....   | 72.4      | 73.4              | " 16 to end.....     | 44.5      | 43.2              |
| June 1 to 15.....  | 69.3      | 72.5              | December 1 to 15.... | 40.9      | 38.6              |
| " 16 to end.....   | 76.5      | 74.7              | " 16 to end.....     | 37.7      | 36.0              |
| 1909               |           |                   |                      |           |                   |
| July 1 to 15.....  | 65.1      | 73.3              | January 1 to 15....  | 39.0      | 36.3              |
| " 16 to end.....   | 71.2      | 75.6              | " 16 to end.....     | 38.2      | 37.0              |
| Aug. 1 to 15.....  | 67.9      | 73.8              | February 1 to 15.... | 37.5      | 38.1              |
| " 16 to end.....   | 64.5      | 71.8              | " 16 to end.....     | 36.1      | 34.0              |
| Sept. 1 to 15....  | 60.9      | 71.4              | March 1 to 15.....   | 38.0      | 33.5              |
| " 16 to end.....   | 67.6      | 71.5              | " 16 to end.....     | 40.7      | 38.2              |

During the construction of the large dam across the Ottawa river above the Chaudière falls considerable blasting was done for the foundation in the limestone rock. It was desired to ascertain whether the shocks would be recorded by the seismograph. By request the engineer-in-charge, Mr. J. B. McCrae, kindly noted the time of discharge as given below:—

| No.    | h. | m. | s. | No. of holes. | Dynamite Sticks. |
|--------|----|----|----|---------------|------------------|
| 1..... | 12 | 15 | 00 | 3             | 3                |
| 2..... | 12 | 17 | 30 | 5             | 5                |
| 3..... | 12 | 24 | 30 | 4             | 4                |
| 4..... | 12 | 29 | 00 | 11            | 11               |
| 5..... | 12 | 48 | 00 | 8             | 8                |
| 6..... | 12 | 52 | 30 | 16            | 16               |

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The holes were 3 feet apart and about 15 inches deep; one stick of dynamite per hole, and the dynamite 50 per cent. The firing was electric. The nature of the limestone rock is more or less shaly. The distance from the Observatory to the dam is in round numbers 10,000 feet, or 3,050 km. The seismogram for the noon hour was carefully examined for any effect of the above blasts, but it failed to reveal the slightest trace. If there was any it was masked by the very small microseisms that were present on that day. Beside the presence of the minute microseisms two other causes militated against obtaining a record; one, the lack of compactness of the rock over that distance, and the other the very rapid oscillations that would be set up to which the seismograph could not well respond.

## EARTHQUAKES RECORDED.

In the following table are given the earthquakes recorded here from January 1, 1908, to March 31, 1909, the end of the fiscal year. On April 1, 1909, began the publication of monthly bulletins of earthquakes and the Göttinger nomenclature adopted by most earthquake stations was also adopted. The preceding three months for 1908 are added in order to have a complete list for that year. Before the adoption of the above nomenclature fewer data were taken from the seismograms than subsequently, which is obvious in the table.

*Göttinger Nomenclature or Designations.*

Character of the earthquake—

*I* = noticeable. *II* = conspicuous. *III* = strong.

*d* = (*terræ motus domesticus*) = local earthquake (sensible or felt).

*v* = ( " " *vicinus* ) = near " (under 1000 km.)

*r* = ( " " *remotus* ) = distant " (1000 to 5000 km.)

*u* = ( " " *ultimus* ) = very distant earthquake (over 5000 km.)

Phases—

*P* = (*undæ primæ* ) first preliminary tremors.

*S* = ( " *secundæ* ) second preliminary tremors.

*L* = ( " *longæ* ) long waves (principal portion).

*M* = ( " *maximæ* ) greatest motion in principal portion.

*C* = (*coda*) = trailers.

*F* = (*finis*) = end of visible disturbance.

Nature of the motion—

*i* = (*impetus*) = beginning.

*e* = (*emersio*) = appearance.

*T* = period = twice time of oscillation.

*A* = amplitude of earth movement, reckoned from zero line.

$A_E = \text{E-W component of } A$   
 $A_N = \text{N-S " " } A$  } measured in microns ( $\mu$ ).

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RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude 45° 23' 38", Longitude 75° 42' 57" or 5<sup>h</sup> 02<sup>m</sup> 51<sup>s</sup>.S W. Greenwich. Elev. 83<sup>m</sup>. Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Göttinger. From January 1, 1908, to March 31, 1909.

| No. | Date.             | Char. | Phase.         | Time.           | Period. | AMPLITUDE.     |                | REMARKS.   |
|-----|-------------------|-------|----------------|-----------------|---------|----------------|----------------|--|
|     |                   |       |                |                 |         | A <sub>E</sub> | A <sub>N</sub> |  |
|     |                   |       |                | h. m. s.        | s.      | μ.             | μ.             |  |
| 1   | Feb. 1. . . . .   | I     | P              | 23 25 20        |         |                |                |  |
|     |                   |       | L              | 23 33 16        |         |                |                |  |
|     |                   |       | F              | 24 09           |         |                |                |  |
| 2   | " 9. . . . .      | I     | P              | 3 28 12         |         |                |                |  |
|     |                   |       | L              | 3 35            |         |                |                |  |
|     |                   |       | F              | 4 06            |         |                |                |  |
| 3   | " 9. . . . .      | I     | P              | 9 15 08         |         |                |                |  |
|     |                   |       | L              | 9 27            |         |                |                |  |
|     |                   |       | F              | 9 42            |         |                |                |  |
| 4   | " 11. . . . .     | I     | P              | 13 09 48        |         |                |                |  |
|     |                   |       | F              | 13 25           |         |                |                |  |
| 5   | " 14. . . . .     | I     | P              | 9 01 04         |         |                |                |  |
|     |                   |       | S              | 9 08 18         |         |                |                |  |
|     |                   |       | L              | 9 14            |         |                |                |  |
|     |                   |       | F              | 9 40            |         |                |                |  |
| 6   | " 14. . . . .     | I     | P              | 11 44 28        |         |                |                |  |
|     |                   |       | S              | 11 47 08        |         |                |                |  |
|     |                   |       | F              | 12 00           |         |                |                |  |
| 7   | Mar. 3. . . . .   | I     | P              | 23 47 48        |         |                |                |  |
|     |                   |       | F              | 24 16           |         |                |                |  |
| 8   | " 5. . . . .      | I     | P              | 2 36 48         | 20      |                |                |  |
|     |                   |       | L              | 3 20            |         |                |                |  |
|     |                   |       | F              | 4 00            |         |                |                |  |
| 9   | " 5. . . . .      | I     | P              | 14 46           |         |                |                |  |
|     |                   |       | F              | 15 03           |         |                |                |  |
| 10  | " 25. . . . .     | I     | P              | 17 02 00        |         |                |                |  |
|     |                   |       | S              | 17 07 34        |         |                |                |  |
|     |                   |       | L              | 17 15           |         |                |                |  |
|     |                   |       | F              | 18 17           |         |                |                |  |
| 11  | " 26. . . . .     | II    | P              | 23 10 12        |         |                |                | Chilapa Mexico, destroyed  |
|     |                   |       | S              | 23 15 50        |         |                |                |  |
|     |                   |       | M <sub>E</sub> | 23 28 40        |         |                |                |  |
|     |                   |       | M <sub>N</sub> | 23 29 40        |         |                |                |  |
|     |                   |       | F              | 2 55            |         |                |                |  |
| 12  | " 27. . . . .     | II    | P              | 3 54 12         |         |                |                | Same epicentre as above.   |
|     |                   |       | S              | 3 59 44         |         |                |                |  |
|     |                   |       | L              | 4 05 28         |         |                |                |  |
|     |                   |       | M              | 4 11            |         |                |                |  |
|     |                   |       | F              | 6 00            |         |                |                |  |
| 13  | April 19. . . . . | I     | P              | 8-16-09         | 5       |                | 5              | Well-marked microseisms mask the P.  |
|     |                   |       | S              | 8-24-14         | 8       | 25             | 10             |  |
|     |                   |       | F              | 9-00- . . . . . |         |                |                |  |
| 14  | April 23. . . . . | I     | S?             | 0-07-36         | 8       | 7              | 2              | Microseisms mask the P.  |
|     |                   |       | L              | 0-52- . . . . . | 20      |                |                |  |
|     |                   |       | F              | 2-16- . . . . . |         |                |                |  |
|     |                   |       | S              | 1-11-20         | 8       | 3              | 2              |  |
| 15  | May 3. . . . .    | I     | S              | 1-35- . . . . . | 22      |                |                | P unrecognizable in the small microseisms. The L of 22' continue for 10 min. |
|     |                   |       | L              | 2-30- . . . . . |         |                |                |  |
|     |                   |       | F              |                 |         |                |                |  |

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude  $45^{\circ} 23' 38''$ , Longitude  $75^{\circ} 42' 57''$  or  $5^{\text{h}} 02^{\text{m}} 51^{\text{s}}.8$  W. Greenwich. Elev.  $83^{\text{m}}$ . Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Güttinger. From January 1, 1908, to March 31, 1909—*Con.*

| No.                  | Date.     | Char.     | Phase                | Time.     | Period. | AMPLITUDE. |       | Remarks.   |
|----------------------|-----------|-----------|----------------------|-----------|---------|------------|-------|--|
|                      |           |           |                      |           |         | $A_E$      | $A_N$ |  |
|                      |           |           |                      | h. m. s.  | s.      | $\mu$      | $\mu$ |  |
| 1908.                |           |           |                      |           |         |            |       |  |
| 16                   | May 5     | <i>I</i>  | <i>P</i>             | 6-40-14   | 5       | 6          | 8     | Microseisms throughout sheet. <i>L</i> not conspicuous till 7 <sup>h</sup> 19 <sup>m</sup> and continue then for 15 minutes. |
|                      |           |           | <i>L</i>             | 7-19-...  | 27      |            |       |  |
|                      |           |           | <i>F</i>             | 8-30-...  |         |            |       |  |
| 17                   | May 15    | <i>Hr</i> | <i>iP</i>            | 8-39-22   | 12      | 3          | 2     | On N-S. component for <i>iP</i> period 3 to 4.   |
|                      |           |           | <i>P</i>             | 8-41-00   | 19      |            |       |  |
|                      |           |           | <i>S</i>             | 8-45-32   | 19      |            |       | Shorter periods of 5 <sup>h</sup> 5 superimposed on <i>L</i> of 33.  |
|                      |           |           | <i>cL</i>            | 8-50-48   | 33      |            |       |  |
|                      |           |           | <i>M</i>             | 8-53-30   |         | 140        | 110   |  |
| 18                   | June 14   | <i>I</i>  | <i>F</i>             | 11-10-... |         |            |       | Epicentral distance 4400 km. Phases unrecognizable.  |
|                      |           |           | <i>cN</i>            | 6-07-36   | 2.6     |            | 6     |  |
|                      |           |           | <i>cE</i>            | 6-09-38   | 7       | 8          |       |  |
| 19                   | June 16   | <i>Id</i> | <i>c</i>             | 20-41-52  | 2       | 8          | 8     | Some windows rattled. Felt in the Observatory and in many places in the city.  |
|                      |           |           | <i>F</i>             | 20-42-04  |         |            |       |  |
| 20                   | June 18   | <i>I</i>  | <i>iP</i>            | 10-46-38  | 4.8     | 2          | 2     | Epicentral distance 3800 km.   |
|                      |           |           | <i>S</i>             | 10-52-16  | 6.6     | 4          | 4     |  |
|                      |           |           | <i>L</i>             | 11-01-28  | 8.5     |            |       |  |
|                      |           |           | <i>M</i>             | 11-08-... |         | 6          | 7     |  |
|                      |           |           | <i>F</i>             | 12-00-... |         |            |       |  |
| 21                   | June 30   | <i>I</i>  | <i>c</i>             | 17-51-30  | 6       |            |       |  |
|                      |           |           | <i>M</i>             | 17-57-... | 11      | 8          | 6     |  |
|                      |           |           | <i>F</i>             | 18-20-... |         |            |       |  |
| 22                   | July 2    | <i>I</i>  | <i>c</i>             | 13-07-22  |         |            |       |  |
|                      |           |           | <i>M<sub>E</sub></i> | 13-15-... | 5       | 2          |       |  |
|                      |           |           | <i>M<sub>N</sub></i> | 13-16-... | 8       |            | 4     |  |
|                      |           |           | <i>F</i>             | 13-28-... |         |            |       |  |
|                      |           |           | <i>P</i>             | 13-28-... |         |            |       |  |
| 23                   | July 8    | <i>I</i>  | <i>P</i>             | 12-58-16  | 6       |            |       | <i>L</i> not well marked. Distance of epicentre 4900 km.   |
|                      |           |           | <i>S</i>             | 13-01-52  | 10      |            |       |  |
|                      |           |           | <i>M</i>             | 13-20-... | 10      | 12         | 4     |  |
|                      |           |           | <i>F</i>             | 14-11-... |         |            |       |  |
| 24                   | July 16   | <i>Ia</i> | <i>P</i>             | 17-00-30  | 5       |            |       | Epicentre 6800 km. Severe earthquake reported from Arica, Chile, but no time stated.   |
|                      |           |           | <i>S</i>             | 17-08-52  | 7       |            |       |  |
|                      |           |           | <i>M</i>             | 17-11-... |         | 7          | 2     |  |
|                      |           |           | <i>M</i>             | 17-54-... | 6       |            | 10    |  |
| 25                   | July 19   | <i>I</i>  | <i>F</i>             | 18-00-... |         |            |       |  |
|                      |           |           | <i>c</i>             | 14-13-40  | 5.3     |            |       |  |
| 26                   | July 26   |           | <i>F</i>             | 14-19-... |         |            |       | The first well-marked "saw-tooth" microseisms, period 5.2, since May 10.   |
| 27                   | August 14 | <i>II</i> | <i>iP</i>            | 0-49-48   | 5.7     | 2          | 2     |  |
|                      |           |           | <i>S</i>             | 0-55-40   | 8       | 10         | 6     |  |
|                      |           |           | <i>iL</i>            | 1-00-08   |         |            |       |  |
|                      |           |           | <i>L</i>             | 1-02-16   | 22      |            |       |  |
|                      |           |           | <i>M<sub>N</sub></i> | 1-03-52   |         |            | 41    |  |
|                      |           |           | <i>M<sub>E</sub></i> | 1-08-16   |         | 71         |       |  |
| 28                   | Aug. 17   | <i>II</i> | <i>c</i>             |           | 7.6     |            |       | Distance to epicentre 3900 km.   |
|                      |           |           | <i>F</i>             | 2-25-...  |         |            |       |  |
|                      |           |           | <i>iP</i>            | 10-56-00  | 4.6     |            |       |  |
|                      |           |           | <i>S</i>             | 11-03-07  | 7       |            |       |  |
|                      |           |           | <i>L</i>             | 11-12-... |         | 8          | 10    |  |
|                      |           |           | <i>M</i>             | 11-12-12  |         |            |       | <i>L<sub>N</sub></i> <i>L<sub>E</sub></i> well marked undulatory.  |
|                      |           |           | <i>L<sub>E</sub></i> | 11-30-... | 32      |            |       |  |
|                      |           |           | <i>L<sub>N</sub></i> | 11-36-... | 29      |            |       |  |
|                      |           |           | <i>L<sub>F</sub></i> | 11-37-... | 20      |            | 8     | Distance to epicentre 5400 km.   |
| <i>L<sub>S</sub></i> | 11-41-... | 21        | 8                    |           |         |            |       |  |
| <i>F</i>             | 13-30-... |           |                      |           |         |            |       |  |

SESSIONAL PAPER No. 25a

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude  $45^{\circ} 23' 38''$ , Longitude  $75^{\circ} 42' 57''$  or  $5^{\text{h}} 02^{\text{m}} 51^{\text{s}}$  W. Greenwich. Elev.  $83^{\text{m}}$ . Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Göttinger. From January 1 1908, to March 31, 1909—*Con.*

| No. | Date.    | Char.                | Phase  | Time.   | Period.  | AMPLITUDE.           |                                       | Remarks.   |
|-----|----------|----------------------|--|---|--|----------------------|---------------------------------------|--|
|     |          |                      |  |   |  | $A_E$                | $A_N$                                 |  |
|     | 1908.    |                      |  | h. m. s.  | s.   | $\mu$                | $\mu$                                 |  |
| 29  | Aug. 18  | <i>I</i>             | <i>c</i><br><i>M</i><br><i>F</i>   | 11-16-08<br>11-20-40<br>11-40   |  |                      | 4                                     | Press despatches report an earthquake at Eureka, California, at about 11 <sup>h</sup> = 3 a.m. Pacific Standard, for which the adjoining is apparently the record. Distance to Eureka 3800 km. |
| 30  | Aug. 19  | <i>I</i>             | <i>cP'</i><br><i>cS'</i><br><i>M</i><br><i>F</i>   | 23-42<br>23-47<br>23-47-48<br>24-00   | 6<br>8   | 7                    | 6                                     |  |
| 31  | Aug. 20  | <i>I</i>             | <i>c</i><br><i>L</i><br><i>F</i>   | 10-21<br>10-43<br>11-33   | 16-20  | 4                    | 2                                     | Phases not distinguishable. E-W component the better shown.  |
| 32  | Aug. 22  | <i>I</i>             | <i>e</i><br><i>S'</i><br><i>M</i><br><i>F</i>  | 19-31<br>19-36-22<br>19-42-00<br>20-15  | 8  | 6                    |                                       |  |
| 33  | Aug. 23  | <i>I</i>             | <i>c</i><br><i>F</i>   | 19-22-28<br>19-26   | 5-7  |                      |                                       |  |
| 34  | Aug. 29  | <i>I</i>             | <i>e</i><br><i>M</i><br><i>L</i><br><i>F</i>   | 18-15-18<br>18-24-10<br>18-25<br>19-00  | 5-6<br>6<br>20                                 |                      | 6                                     |  |
| 35  | Sept. 21 | <i>I<sub>v</sub></i> | <i>e</i><br><i>S</i><br><i>L<sub>N</sub></i><br><i>M<sub>EN</sub></i><br><i>M<sub>SN</sub></i><br><i>M<sub>SE</sub></i><br><i>M<sub>SE</sub></i><br><i>F</i> | 6-43-?<br>6-55-47<br>7-07-40<br>7-09-32<br>-12-16<br>-14-44<br>-14-40<br>-16-08<br>-18-14<br>9-00 | 8<br>8<br>10<br>10<br>9.5<br>8<br>10<br>8<br>8 |                      | 8<br>16<br>16<br>12<br>50<br>37<br>25 | The microseisms mask the <i>P'</i> and interfere with the other phases.  |
| 36  | Sept. 24 | <i>I</i>             | <i>e</i><br><i>cL</i><br><i>F</i>  | 1-05<br>1-09-40<br>1-21   | 16   | 3                    | 2                                     |  |
| 37  | Oct. 13  | <i>I</i>             | <i>iP</i><br><i>iS</i><br><i>M<sub>N</sub></i><br><i>ME</i><br><i>e</i><br><i>ME</i>   | 5-13-26<br>5-19-02<br>5-35-50<br>5-38-00<br>6-52-38<br>7-03-52                                    | 8.5<br>8<br>8.3<br>8                           | 29<br>14<br>50<br>12 | 14<br>35<br>6                         | <i>iL</i> uncertain. Epicentre 3700 km. A second shock appeared before the other had wholly died out.  |
| 38  | Nov. 2   | <i>I</i>             | <i>S</i><br><i>L</i><br><i>M</i><br><i>F</i>   | 5-37-56<br>5-54-20<br>6-43<br>7-40  | 20<br>20                                       | 6<br>14              |                                       | N.-S. component unreadable due to stray microseisms. Some <i>L</i> of 32'. Epicentre 6300 km.  |
| 39  | Nov. 4   | <i>I</i>             | <i>e</i><br><i>F</i>   | 8-54<br>9-20  | 12   |                      |                                       |  |
| 40  | Nov. 6   | <i>I</i>             | <i>P</i><br><i>S'</i><br><i>L</i><br><i>M</i><br><i>F</i>  | 7-31-50<br>7-38-16<br>7-46-35<br>8-02-20<br>10-30   | 6<br>20<br>20<br>16                            | 14<br>29             | 7<br>12                               | Strong microseisms prevailed and partly mask N.-S. component. Epicentre 5900 km.   |

9-10 EDWARD VII., A. 1910

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude  $45^{\circ} 23' 38''$ , Longitude  $75^{\circ} 42' 57''$  or  $5^{\text{h}} 02^{\text{m}} 51^{\text{s}} \text{W}$ . Greenwich. Elev.  $83^{\text{m}}$ . Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Göttinger. From January 1, 1908, to March 31, 1909—*Con.*

| No.   | Date.   | Char.    | Phase     | Time.       | Period. | AMPLITUDE. |       | Remarks.   |
|-------|---------|----------|-----------|-------------|---------|------------|-------|--|
|       |         |          |           |             |         | $A_E$      | $A_N$ |  |
|       | 1908.   |          |           | h. m. s.    | s.      | $\mu$      | $\mu$ |  |
| 41    | Nov. 6  | <i>I</i> | <i>c</i>  | 23-02-?     | .....   | .....      | ..... | Very strong microseisms prevailed, 10 $\mu$ , and almost mask N-S component.                                     |
|       |         |          | <i>L</i>  | 23-14-?     | .....   | .....      | ..... |  |
|       |         |          | <i>ME</i> | 23-16-50    | 10      | 17         | ..... |  |
|       |         |          | <i>MX</i> | 23-16-50    | 6       | 10         | ..... |  |
|       |         |          | <i>F</i>  | 23-45-..... | .....   | .....      | ..... |  |
| 42    | Nov. 9  | <i>I</i> | <i>iP</i> | 15-27-00    | 9       | 6          | ..... | Small microseisms mask N-S component except <i>P</i> . No <i>M</i> distinguishable. Epicentre probably 6,500 km. |
|       |         |          | <i>L</i>  | 15-44-?     | 19      | .....      | ..... |  |
|       |         |          | <i>F</i>  | 17-00-..... | .....   | .....      | ..... |  |
| 43    | Nov. 11 | <i>I</i> | <i>c</i>  | 13-39-10    | 5       | .....      | 2     |  |
|       |         |          | <i>L</i>  | 13-44-40    | .....   | .....      | ..... |  |
|       |         |          | <i>M</i>  | 13-56-..... | 14      | 7          | ..... |  |
|       |         |          | <i>F</i>  | 15-25-..... | .....   | .....      | ..... |  |
| 44    | Nov. 12 | <i>I</i> | <i>c</i>  | 13-51-..... | 13      | 1          | ..... | Very weak: phases unrecognizable.  |
|       |         |          | <i>F</i>  | 15-00-..... | .....   | .....      | ..... |  |
| 45    | Nov. 19 | <i>I</i> | <i>iP</i> | 5-46-.....  | 15      | .....      | ..... | No phases recognizable.  |
|       |         |          | <i>ME</i> | .....       | 15      | 6          | ..... |  |
|       |         |          | <i>F</i>  | 6-26-.....  | .....   | .....      | ..... |  |
| 46    | Nov. 22 | <i>I</i> | <i>c</i>  | 6-45-36     | 8       | 1          | ..... | Not recognizable in N-S component.   |
|       |         |          | <i>L</i>  | 6-53-12     | 16      | 2          | ..... |  |
|       |         |          | <i>L</i>  | 8-09-24     | 20      | 2          | ..... |  |
|       |         |          | <i>F</i>  | 8-30-.....  | .....   | .....      | ..... |  |
| 47    | Nov. 23 | <i>I</i> | <i>c</i>  | 13-04-20    | 6       | 2          | ..... |  |
|       |         |          | <i>M</i>  | 13-54-..... | 22      | 6          | ..... |  |
|       |         |          | <i>F</i>  | 15-00-..... | .....   | .....      | ..... |  |
| 48    | Nov. 30 | <i>I</i> | <i>P</i>  | 21-49-48    | .....   | .....      | ..... |  |
|       |         |          | <i>L</i>  | 21-56-..... | .....   | .....      | ..... |  |
|       |         |          | <i>MX</i> | 21-57-30    | 6       | 75         | ..... |  |
|       |         |          | <i>ME</i> | 21-59-30    | 10      | 125        | ..... |  |
|       |         |          | <i>F</i>  | 23-30-..... | .....   | .....      | ..... |  |
| 49    | Dec. 12 | <i>I</i> | <i>cL</i> | 13-43-40    | .....   | .....      | ..... | Microseisms present.   |
|       |         |          | <i>LE</i> | 13-46-..... | 32      | 4          | ..... |  |
|       |         |          | <i>L</i>  | 13-57-..... | 20      | 4          | 4     |  |
|       |         |          | <i>F</i>  | 14-26-..... | .....   | .....      | ..... |  |
| 50    | Dec. 28 | <i>I</i> | <i>iP</i> | 4-31-04     | 5-6     | 8          | 4     | Strong microseisms, but materially decreased after quake.  |
|       |         |          | <i>L</i>  | 4-39-42     | 20      | .....      | ..... |  |
|       |         |          | <i>MX</i> | 4-56-30     | 16      | .....      | 10    |  |
|       |         |          | <i>ME</i> | 5-00-.....  | 16      | 18         | ..... | Epicentre 7,100 km.  |
|       |         |          | <i>Fx</i> | 6-10-.....  | .....   | .....      | ..... | Postscripts:   |
|       |         |          | <i>Fy</i> | 9-20-.....  | .....   | .....      | ..... | Calabrian quake, 7,300 km  |
| ..... | Dec. 28 | <i>I</i> | <i>P</i>  | 23-22-05    | .....   | 6          | ..... | No other phases recognizable. E-W component not recorded.  |
|       | 1909.   |          | <i>F</i>  | 24-00-..... | .....   | .....      | ..... |  |
| 51    | Jan. 12 | <i>I</i> | <i>P</i>  | 0-04-36     | 4       | 3          | 4     | Earthquake reported from Vancouver, B.C.   |
|       |         |          | <i>F</i>  | 0-22-.....  | .....   | .....      | ..... |  |
|       |         |          | <i>c</i>  | 10-26-..... | .....   | .....      | ..... |  |
|       |         |          | <i>F</i>  | 10-37-..... | .....   | .....      | ..... |  |
| 53    | Jan. 12 | <i>I</i> | <i>c</i>  | 12-30-..... | .....   | .....      | ..... |  |
|       |         |          | <i>M</i>  | 12-35-..... | 12-16   | 4          | 2     |  |
|       |         |          | <i>F</i>  | 12-55-..... | .....   | .....      | ..... |  |
| 54    | Jan. 21 | <i>I</i> | <i>c</i>  | 21-43-..... | .....   | .....      | ..... | No phases recognizable.  |
|       |         |          | <i>MX</i> | 21-47-30    | 6-1     | .....      | 5     |  |
|       |         |          | <i>ME</i> | 21-48-40    | 6-7     | 6          | ..... |  |
|       |         |          | <i>F</i>  | 22-05-..... | .....   | .....      | ..... |  |



SESSIONAL PAPER No. 25a

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude 45° 23' 38", Longitude 75° 42' 57" or 5<sup>h</sup> 02<sup>m</sup> 51<sup>s</sup> W. Greenwich. Elev. 83<sup>m</sup>. Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Göttinger. From January 1, 1908, to March 31, 1909—*Con.*

| No. | Date.      | Char.    | Phase     | Time.     | AMPLITUDE. |         |         | REMARKS.   |
|-----|------------|----------|-----------|-----------|------------|---------|---------|--|
|     |            |          |           |           | Period.    | $A_N$   | $A_E$   |  |
|     |            |          |           | h. m. s.  | s.         | $\mu$ . | $\mu$ . |  |
|     | 1909.      |          |           |           |            |         |         |  |
| 55  | Jan. 23.   | <i>I</i> | <i>P</i>  | 3-01-13   |            |         |         | Epicentre estimated at 9,400 km.                             |
|     |            |          | <i>S</i>  | 3-11-42   |            |         |         |  |
|     |            |          | <i>L</i>  | 3-28-?    |            |         |         |  |
|     |            |          | <i>L</i>  | 3-32-..   | 24         |         |         |  |
|     |            |          | $M_N$     | 3-35-..   | 24         |         | 6       |  |
|     |            |          | $M_E$     | 3-37-..   | 22         | 8       |         |  |
|     |            |          | <i>F</i>  | 4-50-..   |            |         |         |  |
| 56  | Feb. 9.    | <i>I</i> | <i>e</i>  | 12-01-..  |            |         |         | Well-marked microseisms prevail.                             |
|     |            |          | <i>L</i>  | 12-06-..  | 20         |         |         |  |
|     |            |          | <i>F</i>  | 12-21-..  |            |         |         |  |
| 57  | Feb. 16.   | <i>I</i> | <i>P</i>  | 16-31-20? |            |         |         | Epicentre 8,400 km.  |
|     |            |          | <i>L</i>  | 16-54-20  | 6          |         |         |  |
|     |            |          | $M_N$     | 16-55-00  | 6          |         | 30      |  |
|     |            |          | $M_E$     | 16-55-40  | 7          | 40      |         |  |
|     |            |          | <i>F</i>  | 17-35-..  |            |         |         |  |
| 58  | Feb. 22    | <i>I</i> | <i>P</i>  | 9-40-00   |            |         |         | Microseisms present.   |
|     |            |          | <i>S</i>  | 9-45-06   |            |         |         | Epicentre 3,500 km.  |
|     |            |          | <i>LF</i> | 9-48-29   | 7          |         |         |  |
|     |            |          | <i>M</i>  | 9-52-40?  | 7          | 20      |         |  |
|     |            |          | <i>F</i>  | 11-20-..  |            |         |         |  |
| 59  | Feb. 26.   | <i>I</i> | <i>P</i>  | 16-53-35  |            |         |         | Well-marked microseisms.                                     |
|     |            |          | <i>S</i>  | 16-59-16  |            |         |         | Epicentre 3,900 km.  |
|     |            |          | <i>L</i>  | 17-01-23  |            |         |         |  |
|     |            |          | <i>M</i>  | 17-05-12  | 12         |         | 50      |  |
|     |            |          | <i>F</i>  | 17-38-..  |            |         |         |  |
| 60  | Mar. 12/13 | <i>I</i> | <i>e</i>  | 23-42-..  |            |         |         |  |
|     |            |          | <i>L</i>  | 0-07-..   |            |         |         |  |
|     |            |          | $M_E$     | 0-14-..   | 20         |         | 6       |  |
|     |            |          | <i>F</i>  | 1-38-..   |            |         |         |  |
| 61  | Mar. 13.   | <i>I</i> | <i>P</i>  | 11-42-20  |            |         |         |  |
|     |            |          | <i>S</i>  | 14-52-40  |            |         |         |  |
|     |            |          | <i>L</i>  | 15-16-32  | 20         |         |         |  |
|     |            |          | <i>M</i>  | 15-19-30  | 27         |         | 6       |  |
|     |            |          | <i>F</i>  | 17-00-..  |            |         |         |  |
| 62  | Mar. 18.   | <i>I</i> | <i>eL</i> | 0-03-40   | 24         |         |         | Irregularities due to winds and microseisms mask the phases. |
|     |            |          | <i>F</i>  | 0-20-..   |            |         |         |  |

During this period of fifteen months sixty-two earthquakes were recorded and but one of them of Canadian origin, and that one in the vicinity of Ottawa. Popularly the severity of an earthquake is measured by the destruction of life and property, which is however by no means the criterion for the seismologist when considering it as a tectonic movement. There were three earthquakes by which much destruction was done: the two shocks of March 26-27 by which Chilapa, on the Pacific slope of Mexico was destroyed; then the great disaster of Messina, also spoken of as the Calabrian earthquake; and the Persian one of January 23, 1909.

Most of the other quakes probably occurred at sea and hence give us no evidence from the epicentre or central area of disturbance unless it be through the breaking of submarine cables. However, with the great improvement of earthquake instruments in recent years, with increased sensitiveness and more accurate time-scale, it

will now be possible to locate with a fair degree of accuracy every earthquake that is recorded at a number of widely separated stations. There is yet room for improvement in sensitiveness, especially for recording the first preliminary tremors, and also in the time record; the clock correction, if any, should be within a second of time. The time-scale on our photographic seismogram is made by a shutter, actuated electrically by our normal standard mean time clock, and so far has never required a correction of a second. The light is cut off every minute for two seconds and the 60th minute is omitted in order to identify the hour.

With well marked phases on a seismogram and good time-scale, the distance to the epicentre of a tectonic quake can be obtained within say 100 km. or 60 miles. The direction of the seat of disturbance, however, can not be so well deduced. Were the matter through which the earthquake waves are propagated homogeneous, then the components of the two pendulums placed generally in the N.-S. E.-W. directions at each station would furnish some indication of the direction sought, and thus enable each station to obtain at least an approximate position for the epicentre. The complete analysis of the seismograms is yet remote.

That the velocity of the first and second preliminary tremors or longitudinal and transverse waves respectively is a function of the distance is well illustrated in the accompanying table which has been compiled of the Messina earthquake. Time of occurrence at Messina is taken as 4<sup>h</sup> 20<sup>m</sup> Greenwich mean time (Professor Rizzo). The seismogram records were obtained from the various subjoined stations, and the distances were directly taken from our 30-inch globe with a flexible steel tape especially graduated to represent 10,000 km. for the quadrant. A globe of this size with such a graduated tape is of great service in the study of earthquakes and their epicentres.

*P*, *S*, *L* represent respectively the time of arrival of the first preliminary, the second preliminary, and the long waves.

## MESSINA EARTHQUAKE.

| Place.          | Dis-<br>tance. | Middle<br>ordinate<br>to<br>Chord. | <i>P</i> | <i>S</i> | <i>L</i> | Velocity per Minute. |          |          | $\frac{S}{P}$ |
|-----------------|----------------|------------------------------------|----------|----------|----------|----------------------|----------|----------|---------------|
|                 |                |                                    |          |          |          | <i>P</i>             | <i>S</i> | <i>L</i> |               |
|                 | km.            | km.                                | h m s    | h m s    | h m s    | km.                  | km.      | km.      |               |
| Ottawa.....     | 7200           | 992                                | 4 31 04  | 4 39 42  | .....    | 651                  | 365      | .....    | .56           |
| Washington..... | 7650           | 1116                               | 4 31 23  | 4 40 30  | .....    | 672                  | 373      | .....    | .56           |
| Tiflis.....     | 2550           | 128                                | 4 25 33  | 4 29 50  | 4 35 20  | 458                  | 259      | 166      | .57           |
| Cartuja.....    | 1700           | 56                                 | 4 23 35  | 4 26 40  | 4 27 50  | 474                  | 255      | 217      | .54           |
| Sarajevo.....   | 700            | 10                                 | 4 21 51  | 4 23 09  | 4 23 54  | 378                  | 222      | 180      | .59           |
| Belgrade.....   | 850            | 14                                 | 4 22 09  | 4 23 11  | 4 24 12  | 395                  | 267      | 202      | .68           |
| Laibach.....    | 900            | 16                                 | 4 22 18  | 4 23 33  | 4 24 16  | 391                  | 254      | 211      | .65           |
| Vienna.....     | 1100           | 24                                 | 4 22 55  | 4 25 17  | 4 26 16  | 377                  | 208      | 175      | .55           |
| Cracow.....     | 1400           | 38                                 | 4 23 23  | 4 25 59  | 4 26 48  | 413                  | 234      | 206      | .56           |
| Hamburg.....    | 1750           | 60                                 | 4 24 16  | 4 27 18  | 4 28 12  | 410                  | 240      | 213      | .58           |
| Aachen.....     | 1600           | 50                                 | 4 23 53  | 4 26 38  | .....    | 412                  | 241      | .....    | .58           |
| Toronto.....    | 7500           | 1073                               | 4 31 12  | 4 39 48  | 5 00 00  | 670                  | 379      | 187      | .57           |
| Victoria.....   | 9550           | 1709                               | 4 33 12  | 4 43 36  | 5 06 36  | 723                  | 405      | 205      | .56           |
|                 |                |                                    |          |          |          | Mean.....            |          | 196.2    |               |
|                 |                |                                    |          |          |          | Per second.....      |          | 3.27     |               |

The ratio  $\frac{S}{P}$  is pretty constant, with the exception of the three stations, Sarajevo, Belgrade and Laibach, which are all less than 1,000 km. from the epicentre, and for which the ordinates to the chords are small, from 10 to 16 km., not reaching to the supposed layer of isostatic adjustment.

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The degree of accuracy of the time element in the records for deducing velocities is of far more consequence for close stations than for very distant ones. However in the above, which comprise all the data available at the time, there does not appear to be any serious discrepancy in the reading of the various seismograms. The *L* waves show themselves conspicuously as being propagated over the same medium for all stations, that is, along the surface, by having the same velocity. Thus the velocity from origin to Cracow is the same as to Victoria, seven times as distant. Although there are some variations in the velocity of the surface waves, they are wholly independent of the distance, and most likely attributable to the difficulty of sometimes identifying the arrival of the long waves in the medley of the other waves and their reflections which precede.

As the time of the occurrence of the severe earthquake in Persia of January 23, 1909, was not reported, and the time service in those regions is in any case probably very unsatisfactory with reference to Standard or Greenwich time, an attempt has been made to determine the time of the occurrence at the epicentre, based on the press despatch that the epicentre was at Bahrein, and on the times of arrival of the first and second preliminary tremors (*P* and *S*) at various stations of which the records had been received. The geographical position of Bahrein is taken from Stieler's *Hand Atlas*,  $\phi = 33^\circ 30'$ ,  $\lambda = 49^\circ 30'$  E. Greenwich. The distances are taken from our 30-inch globe.

In the following table the computed transmission times  $V_1$ ,  $V_2$  for the *P* and *S* are interpolated from the Wiechert-Zeppritz values compounded from the Indian earthquake of 1905, the Calabrian one of 1905, and the San Francisco one of 1906.

For *L* the velocity is taken at 4 km. per second.

EARTHQUAKE OF JANUARY 23, 1909.

BAHREIN, PERSIA.

$\phi = 33^\circ 30'$ ,  $\lambda = 49^\circ 30'$  E. OF GR.

GREENWICH TIME.

| Station.            | Dis-<br>tance.<br>km. | Ordin-<br>ate.<br>km. | Seismograms. |          |          | Computed. |            |          | Deduced time at<br>Epicentre. |                  |                     |
|---------------------|-----------------------|-----------------------|--------------|----------|----------|-----------|------------|----------|-------------------------------|------------------|---------------------|
|                     |                       |                       | <i>P</i>     | <i>S</i> | <i>L</i> | $V_1$     | $V_2$      | <i>B</i> | <i>P</i> - $V_1$              | <i>S</i> - $V_2$ | <i>L</i> - <i>B</i> |
|                     |                       |                       | h m s        | h m s    | h m s    | m s       | m s        | m s      | h m s                         | h m s            | h m s               |
| Ottawa . . . . .    | 9750                  | 1778                  | 3 01 13      | 3 11 42  | 3 28 . . | 12 54 23  | 38 40 37   | 2 48 13  | 2 48 04                       | 2 47 23          |                     |
| Hamburg. . . . .    | 3830                  | 287                   | 2 55 14      | 3 00 36  | 3 03 12  | 7 07 12   | 40 15 57   | 48 07    | 47 56                         | 47 15            |                     |
| Aachen. . . . .     | 4020                  | 315                   | 2 55 33      | 3 01 05  | 3 04 56  | 7 21 13   | 06 16 45   | 48 12    | 47 59                         | 48 11            |                     |
| Trieste. . . . .    | 3330                  | 217                   | 2 54 42      | 2 59 42  | 3 04 41  | 6 22 11   | 22 13 52   | 48 20    | 48 20                         | 50 49            |                     |
| *Sarajevo. . . . .  | 2920                  | 168                   | 2 55 30      | 3 00 09  | 3 03 36  | 5 52 10   | 24 12 10   | 48 38    | 48 45                         | 50 26            |                     |
| Cracow. . . . .     | 3060                  | 183                   | 2 54 08      | 2 58 59  | 3 00 56  | 6 00 10   | 43 . . . . | 48 08    | 48 16                         | .. . .           |                     |
| Vienna. . . . .     | 3200                  | 200                   | 2 54 18      | 2 59 10  | 3 00 56  | 6 13 11   | 07 13 20   | 48 05    | 48 03                         | 47 36            |                     |
| Tiflis. . . . .     | 1030                  | 21                    | 2 50 40      | .. . . . | .. . . . | 2 19 4    | 04 . . . . | 48 21    | .. . . .                      | .. . . .         |                     |
| Strassburg. . . . . | 3850                  | 250                   | 2 55 09      | 3 00 26  | 3 05 26  | 7 09 12   | 40 16 02   | 48 00    | 47 46                         | 49 24            |                     |
| Laibach. . . . .    | 3300                  | 213                   | 2 54 20      | 2 59 15  | 3 04 17  | 6 21 11   | 16 13 45   | 47 59    | 47 59                         | 50 32            |                     |
| Belgrade. . . . .   | 2650                  | 137                   | 2 53 26      | 2 57 53  | 3 01 42  | 5 27 9    | 42 11 02   | 47 59    | 48 11                         | 50 40            |                     |
| Cartuja. . . . .    | 4820                  | 450                   | 2 56 33      | 3 03 05  | 3 07 30  | 8 20 14   | 48 20 05   | 48 13    | 48 17                         | 47 25            |                     |
| Washington. . . . . | 10300                 | 1972                  | 3 01 22      | 3 12 05  | 3 30 . . | 13 18 24  | 28 42 55   | 48 04    | 47 37                         | 47 05            |                     |
| Mean. . . . .       |                       |                       |              |          |          |           |            |          | 2 48 11                       | 2 48 06          | 2 48 48             |

It will be observed from the above table that the mean time deduced from the *P* agrees within 5 seconds of the mean of the deduced time from the *S*, so that one feels justified in giving for the time of the occurrence of the quake in Persia 2<sup>h</sup> 48<sup>m</sup> 8<sup>s</sup>

\* Times evidently one minute too late.

Greenwich time. The agreement between the two independent values  $P - V_1$  and  $S - V_2$  for any station is satisfactory too; in several cases the times are absolutely co-incident. However, we cannot always be sure of individual seconds in reading  $P$  and  $S$  on the seismogram.

A greater difficulty we encounter when trying to read on the seismogram the arrival of the long waves,  $L$ , and this is manifested in the last column, which in the ideal condition we should expect to agree with the other two. The discordances in the last column of individual values from the general mean ( $2^h 45^m 08^s$ ) of the other two columns is not attributable to the assumption of 4 km. as the velocity of the long waves per second, but rather to the reading of the various seismograms. For, taking  $T = 2^h 45^m 08^s$  as the time of the occurrence of the quake and solving by least squares for the velocity of the long waves we get 238 km. per minute, which is practically the same as 4 km. per second, the quantity used.

If we arrange  $L - T$  in the order of magnitude and divide the resulting time into the respective distance of the station from the epicentre it will be found that there is a tendency for the greater distance to give the greater velocity; the extreme values being Hamburg 4.24 km., and Belgrade 3.26 km. per second.

We may recall the table of the Calabrian or Messina quake, which gave for Belgrade 3.36 km., and for Hamburg 3.55 km., and the general mean 3.27 km. In no case for that quake was a velocity obtained as high as 4 km., the highest being for Cartuja 3.61 km. per second.

Judging from our seismograms here, it is believed that the discordances obtained for the velocity of the long waves are mostly or wholly attributable to the uncertainty of identifying, midst the complexity of longitudinal and transverse waves and their reflections which precede, the arrival of the surface or long waves.

Some of the stations on this continent failed to get a record of the first preliminary tremors, due to lack of sensitiveness of the instrument. For distant quakes not only the diminished force of the longitudinal impulse comes into play, but also the horizontal component of that impulse, so that distance very materially militates against the recording of the first preliminary tremors.

The following table is a compilation of the two preceding ones, and arranged in order of distance with the corresponding middle ordinate to the chord, and the mean velocity of the first preliminary tremors,  $P$ , or longitudinal waves in kilometres per minute.

FOR MESSINA AND BAHREIN EARTHQUAKES.

| Place.   | Distance. | Ordinate. | Velocity P. | Place.     | Distance. | Ordinate. | Velocity P. |
|----------|-----------|-----------|-------------|------------|-----------|-----------|-------------|
|          | km.       | km.       | km.         |            | km.       | km.       | km.         |
| Sarajevo | 700       | 10        | 378         | Vienna     | 3,200     | 200       | 519         |
| Belgrade | 850       | 14        | 395         | Laibach    | 3,300     | 213       | 532         |
| Laibach  | 900       | 16        | 391         | Trieste    | 3,330     | 217       | 507         |
| Tiflis   | 1,030     | 21        | 407         | Hamburg    | 3,830     | 287       | 540         |
| Vienna   | 1,100     | 24        | 377         | Strassburg | 3,850     | 290       | 519         |
| Cracow   | 1,400     | 38        | 413         | Aachen     | 4,020     | 315       | 542         |
| Aachen   | 1,600     | 50        | 412         | Cartuja    | 4,820     | 450       | 573         |
| Cartuja  | 1,700     | 56        | 474         | Ottawa     | 7,200     | 992       | 651         |
| Hamburg  | 1,750     | 60        | 410         | Toronto    | 7,500     | 1,073     | 670         |
| Tiflis   | 2,550     | 128       | 458         | Washington | 7,650     | 1,116     | 672         |
| Belgrade | 2,650     | 137       | 500         | Victoria   | 9,550     | 1,709     | 723         |
| Sarajevo | 2,920     | 168       | 396         | Ottawa     | 9,750     | 1,778     | 745         |
| Cracow   | 3,060     | 183       | 510         | Washington | 10,300    | 1,972     | 778         |

There are some discrepancies in the table, notably the one for Sarajevo. From information received it would appear that it is mostly due to an error or inaccuracy

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in time scale. If the phenomenal progress that seismology has made in recent years continues, such discrepancies will disappear and data of a high order of precision will be obtained, upon which a permanent structure can be raised.

There are now some 200 earthquake stations distributed over the earth, and the seismograms furnished by them are far from homogeneous, and are far from equal merit and value for studying the geophysical problems for which they are obtained. The first order of precision to be aimed at is that of time. Seismology demands now that the time recorded should be accurate within at least one second. As standard time is now so widely distributed by telegraph, there seems no reason why the time of every earthquake station should not be controlled by the time from some astronomical observatory. In order to be able to read to one second on the seismogram the time scale should be about 90cm. to the hour, or 15mm. to the minute; *i.e.*, 1mm. would represent 4 seconds. There is a limit to the speed of the revolving cylinder, for if it is too great, although the time could then be more accurately read, yet, waves with small amplitudes would become so flattened as to be scarcely recognizable. A further demand for precision, is that the instrument be highly sensitive in order that the first impulse of the first preliminary tremors is recorded, and that damping co-efficient should approach the limit of aperiodicity for the pendulum, in order that the seismogram may represent fairly well the earth movements and free from those of the pendulum itself.

#### CANADIAN EARTHQUAKES.

Looking at a geological map of Canada one is immediately impressed with the fact that the greater part of the Dominion, running from the Gulf of St. Lawrence past Hudson bay and on to Great Bear lake and the Arctic ocean, is composed essentially of archæan rock, that is, of the oldest formation on the earth. This is probably the largest area of archæan rock on the earth, being closely followed by the Scandinavian peninsula and Finland. As earthquakes are intimately associated with the age of rock formation, the more recent being more subject to disturbances than the older ones, we may say that broadly speaking the vast area above referred to will always be fairly free from earthquakes, for its compact and more or less homogeneous nature is not so well adapted to the adjustment of the strains of the earth's crust, which is the cause of earthquakes, as the newer formations are, which are intersected by dikes and faults, and which exhibit stratification and folding with, consequently, lines and surfaces of weakness.

In the St. Lawrence valley, westward from Quebec to Lake Huron, we have formations of the Palæozoic age, and also to the south of the St. Lawrence covering New Brunswick and Nova Scotia. In the whole of eastern Canada from Nova Scotia to near the mouth of the Mackenzie river, a distance of nearly 3,000 miles, no formations more recent than those of the Palæozoic age are found. In western Canada the newer formations occur; the Great Plains being represented by the Cretaceous and Tertiary eras. The mainland Pacific coast of British Columbia is almost wholly 'coast granite,' while the interior is largely represented by the Miocene period of the Tertiary era. The nature, composition and structure of the formation itself may, *per se*, directly lead through gravitational effect to earthquakes. While on the other hand such formation may lend itself to the adjustment of stresses imposed upon it from neighbouring regions, *e.g.* the sea or ocean. So much is obvious, that whatever reason we may assign as the contributory cause of an earthquake, where it occurs is necessarily the weak spot for the area under strain. From historic records and of late years from instrumental records the seismic areas of the earth are fairly well known, but why the degree of seismicity should vary in different regions is open to considerably more elucidation. The Indo-Pacific archipelago, including Sumatra, Java, New Guinea and the Philippines is the most seismic region of the earth for the larger quakes, while the eastern coast of Canada is fairly immune.

The more or less severe, but not destructive, earthquakes that have visited eastern Canada are all associated more or less directly with the 'Great Champlain and St. Lawrence fault,' running from the gulf up the river to Quebec and then curving southwesterly to Lake Champlain. Of these the quakes of 1663, 1791, 1860 and 1870 are the most noted. The first one has gained a certain celebrity from its exaggerated description. This earthquake, which lasted about six months, occurred during the French occupation. We may regard the record of this as the beginning of our literature on seismology, and hence give it a place here, although its scientific value is rather circumscribed.

From a manuscript in the Jesuits' College at Quebec the editor of 'Hochelaga Depicta' took the following account of this quake:—

'On the 5th of February, 1663, about half past five in the evening a great rushing noise was heard throughout the whole extent of Canada. This noise caused the people to run out of their houses into the streets, as if their habitations had been on fire; but instead of flames or smoke, they were surprised to see the walls reeling backwards and forwards, and the stones moving, as if they were detached from each other. The bells sounded by the repeated shocks. The roofs of the buildings bent down, first on one side and then on the other. The timbers, rafters and planks cracked. The earth trembled violently, and caused the stakes of the palisades and palings to dance in a manner that would have been incredible had we not actually seen it in many places. It was at this moment every one ran out of doors. There were to be seen animals flying in every direction, children crying and screaming in the streets; men and women seized with affright, stood horror-struck with the dreadful scene before them, unable to move, and ignorant where to fly for refuge from the tottering walls and trembling earth, which threatened every instant to crush them to death, or to sink them into a profound and unmeasurable abyss. Some threw themselves on their knees in the snow, crossing their breasts and calling on their saints to relieve them from the dangers with which they were surrounded. Others passed the rest of this dreadful night in prayer, for the earthquake ceased not, but continued at short intervals, with a certain undulating impulse, resembling the waves of the ocean, and the same qualmish sensations, or sickness of the stomach, was felt during the shocks as is experienced on a vessel at sea. . . . The violence of the earthquake was greatest in the forests, where it appeared as if there was a battle raging between the trees; for not only their branches were destroyed, but even their trunks are said to have been detached from their places and dashed against each other with inconceivable violence and confusion, so much so, that the Indians in their figurative manner of speaking, declared that all the forests were drunk. The war also seemed to be carried on between the mountains, some of which were torn from their beds and thrown upon others, leaving immense chasms in the places from whence they had issued, and the very trees with which they were covered sunk down, leaving only their tops above the surface of the earth; others were completely overturned, their branches buried in the earth and the roots only remained above ground. During this general wreck of nature the ice, upwards of six feet thick, was rent and thrown up in large pieces, and from the openings in many parts, there issued thick clouds of smoke, or fountains of dirt and mud, which spouted up to a very considerable height. The springs were either choked up or impregnated with sulphur.—many rivers were totally lost, others were diverted from their course and their waters entirely corrupted. Some of them became yellow, others red, and the great River of St. Lawrence appeared entirely white as far down as Tadousac. This extraordinary phenomenon must astonish those who know the size of the river, and the immense body of water in various parts, which must have required such an abundance of matter to whiten it. They write from Montreal that during the earthquake they plainly saw the stakes of the picketing or palisades jump up as if they had been dancing; and that of two doors in the same room, one opened and the other shut of their own accord; that the

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chimneys and tops of the houses bent like branches of trees agitated with the wind; that when they went to walk they felt the earth following them and rising at every step they took, sometimes sticking against the soles of their feet and other things in a very forcible and surprising manner. . . . From Three Rivers they write that the first shock was the most violent, and commenced with a noise resembling thunder. The houses were agitated in the same manner as the tops of trees during a tempest, with a noise as if fire was crackling in the garrets. The shock lasted half an hour, or rather better, though the greatest force was properly not more than a quarter of an hour; we believe there was not a single shock which did not cause the earth to open either more or less. As for the rest, we have remarked that, though this earthquake continued almost without intermission, yet it was not always of an equal violence. Sometimes it was like the pitching of a large vessel which dragged heavily at her anchors; and it was this motion that caused many to have a giddiness in their heads and qualmishness at their stomachs. At other times the motion was hurried and irregular, creating sudden jerks, some of which were extremely violent; but the most common was a slight tremulous motion, which occurred frequently with little noise. Many of the French inhabitants and Indians, who were eye-witnesses to the scene, state that a great way up the river of Trois Rivières, about 18 miles below Quebec, the hills which bordered the river on either side, and which were of a prodigious height, were torn from their foundations and plunged into the river, causing it to change its course and spread itself over a large tract of land recently cleared; the broken earth mixed with the waters, and for several months changed the colour of the great River St. Lawrence, into which that of Trois Rivières disembogues itself. In the course of this violent convulsion of nature, lakes appeared where none ever existed before; mountains were overthrown, swallowed up by the gaping, or precipitated into adjacent rivers, leaving in their places frightful chasms or level plains; falls and rapids were changed into gentle streams, and gentle streams into falls and rapids. Rivers in many parts of the country sought other beds or totally disappeared. The earth and the mountains were entirely split and rent in innumerable places, creating chasms and precipices whose depths have never yet been ascertained. Such devastation was also occasioned in the woods, that more than a thousand acres in one neighbourhood were completely overturned, and where but a short time before nothing met the eye but one immense forest of trees, now were to be seen extensive cleared lands apparently cut up by the plough . . . At Tadousac, about 150 miles below Quebec on the north side, the effect of the earthquake was not less violent than at other places; and such a heavy shower of volcanic ashes fell in that neighbourhood, particularly in the River St. Lawrence, that the waters were as violently agitated as during a tempest. Near St. Paul's bay, about 50 miles below Quebec on the north side, a mountain about a quarter of a league in circumference, situated on the shore of the St. Lawrence, was precipitated into the river, but, as if it had only made a plunge, it rose from the bottom and became a small island, forming with the shore a convenient harbour, well sheltered from all winds. Lower down the river, towards Point Alouettes, an entire forest of considerable extent was loosened from the main bank and slid into the River St. Lawrence, where the trees took fresh root.

There are three circumstances, however, which have rendered this extraordinary earthquake particularly remarkable: the first is its duration, it having continued from February to August, that is to say, more than six months almost without intermission. It is true, the shocks were not always equally violent. In several places, as towards the mountain behind Quebec, the thundering noise and trembling motion continued successively for a considerable time. In others, as towards Tadousac, the shock continued generally for two or three days at a time with much violence. . . . The second circumstance relates to the extent of this earthquake, which we believe was universal throughout the whole of New France, for we learn that it was felt from l'Isle Percée and Gaspé, which are situate at the mouth of the St. Lawrence to

beyond Montreal, as also in New England, Acadia and other places more remote. As far as it has come to our knowledge, this earthquake extended more than 600 miles in length and about 300 in breadth. Hence 180,000 square miles of land were convulsed in the same day and at the same moment.

The third circumstance, which appears the most remarkable of all, regards the extraordinary protection of Divine Providence which has been extended to us and our habitations; for we have seen near us the large openings and chasms which the earthquake occasioned, and the prodigious extent of country which has either been totally lost or hideously convulsed, without our losing either man, woman or child, or even having a hair of their heads touched.

We might add a fourth circumstance, and that is, that the narrators of the above anticipated the sensationalism of our 'yellow' journals by two and a half centuries.

The following is a list of the slight local shocks occurring in Canada from January 1, 1908, to April 30, 1909. The items were gathered from the daily press:—

#### 1908.

May 12.—A very perceptible shock of earthquake was felt in Yarmouth, N.S., and vicinity a few minutes before 12 on Wednesday night. Houses shook and trembled and there was a loud report as of heavy thunder. No damage has been reported. It was bright moonlight and calm at the time. It was likewise felt in Digby, Annapolis and Shelburne counties.

June 16.—A distinct shock occurred at Ottawa, and was recorded by the seismograph at 3<sup>h</sup> 41<sup>m</sup> 52<sup>s</sup> p.m., the pulsations lasting 16 seconds. It was generally felt; windows rattled, and some heard a loud rumbling sound. On the Rossi-Forel scale the intensity would be designated by IV. It was felt over an area about 60 miles in diameter.

July 17.—Quite a distinct shock was felt at Arnprior at 2<sup>h</sup> 10<sup>m</sup> a.m. A great many citizens felt it. The quake was accompanied by a noise similar to that of a large building falling.

August 8.—Despatches from the up-river section of New Brunswick report earthquake shocks in several places this morning. At Hartland there were three shocks at 1, 4 and 7 a.m. Plaster fell from the ceiling in one building. In Fredericton and vicinity there was a shock felt about 7 o'clock. Thunder and lightning and very heavy rain were experienced during the night.

November 30.—An earthquake travelling apparently from north to south threw the inhabitants of the town of Skidegate, Queen Charlotte islands, into a state of nervous apprehension in the afternoon of November 30, according to news brought south by the fishing steamer *Celestial Empire*, which reached Vancouver yesterday morning (December 9) from the northern halibut banks. It was estimated that the shock lasted fully seven seconds. No other tremors were felt, greatly to the relief of the people of the town, who became somewhat alarmed on observing that two Indian shacks had been thrown to the ground. The buildings knocked down were old, half-tumbled-down affairs.

#### 1909.

January 11.—Nearly all parts of southern British Columbia and Washington Territory, across the international boundary, were shaken by an earthquake at 3.15 p.m., Pacific standard time of January 11, the quake lasting from 10 to 20 seconds. No damage was done but the alarm was very great. Beyond the breaking of some crockery in a few homes in Victoria, there was little damage caused. Comox, Alberni, Pachena, Bamfield and other points report having felt the shock, Bamfield stating that two tremors were felt, while Estevan reports that no shock was experienced there. At Port Townsend, across the boundary line, in many places where water pipes lay in the frozen ground, the earthquake broke the pipes and flooded houses.



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January 31-February 1.—Three distinct earthquake shocks were felt in Montreal last night. The first shock was felt at 11<sup>h</sup> 30<sup>m</sup> p.m., the second at 11<sup>h</sup> 45<sup>m</sup>, and the third and most severe at 3<sup>h</sup> 20<sup>m</sup> a.m. People were awakened all over the city. The rattling of glassware and crockery was heard distinctly. A peculiar feature was the howling of dogs all over the city. Loud cracking as though houses were being severely strained was noticed everywhere. A number of houses are cracked as the result of the quakes, also some sidewalks.

February 3.—At about 4 a.m. quite a number of people in Montreal were aroused by an unusual sound and a slight sense of vibration, which lasted only a very short time and was not repeated. It was less severe than the preceding one of two days ago.

Examining the geological areas for the above places it is not difficult to understand that local shocks may occur there. The complexity of the formations; the differences in composition, in density, in elasticity; the many faults and dikes; the numerous surfaces of contact; the constant gravitational effect, all conspire towards the interruption of a continuous gradual adjustment of stresses and strains, so that at times these adjustments, though very minute, are abrupt and manifest themselves as local shocks. That these adjustments are very small is shown by the very small acceleration produced. Acceleration is the measure of intensity of an earthquake.

In the above local shocks there is only one, that for Ottawa, for which direct measures were obtained. We find from them that the acceleration produced was 2.4 millegals.

The unit of acceleration in the C. G. S. system is called a 'gal', *i.e.*, the acceleration of 1cm per second, per second; hence for gravity at latitude 45° we have 980.60 gals. A millegal is the thousandth of a gal.

Small local shocks like the above may occur almost anywhere, at least in many localities over the southern part of Canada from Nova Scotia to British Columbia.

It may be remarked, however, that when we reach the Pacific coast we enter upon ground adapted to tectonic or the larger quakes. Vancouver island, Queen Charlotte islands and the smaller islands all lie in comparatively shallow water, but immediately to the west lies the deep trough of the Pacific, adapted for breeding seismic disturbances on a large scale.

#### MICROSEISMS.

In order to treat this subject as fully as the data and records here warrant, some of the matter published last year is here incorporated for the sake of completeness.

Under the designation microseisms, are included all pulsations not directly attributable to what are generally known as earthquakes, which give abrupt, more or less violent, and momentary movements of the earth's crust, the effect of which may, however, continue for some hours. Attempts have been made to classify these microseisms according to their cause, but so far without complete success. During the past year the writer has paid considerable attention to these disturbances, and in doing so has studied and compared the daily seismograms with our daily micro-barograms, our weekly aneroid barograms and also with the daily weather maps, which give the isobars at 8 a.m. for Canada and the United States, roughly between latitudes 25° and 55°, and the Atlantic and Pacific oceans. The micro-barogram exhibits particularly well very rapid fluctuations of pressure as manifested by local and often gusty winds, the counterpart of which is always represented on the seismogram by irregular movements and not by microseisms. The average time of the beginning of the seismogram sheet is about 10 a.m., so that the above isobars and gradients dependent upon them are for a time preceding the former by two hours. From the examination of the local barogram alone not much information can be gathered as to the behaviour of the seismograph except when very rapid and marked fluctuations, say a millimetre or more, take place in the pressure, comparable with the 'pumping' of a mercurial

barometer at sea. The barometer may show little or no change in pressure at a given place, yet areas of 'High' and 'Low' (barometer) may be rushing along to the north and south of it, setting up vibrations or pulsations of the earth's surface that may be markedly felt at a given place by the seismograph. Similarly from a large rise or fall of the barometer during 24 hours at a given place alone, we can draw no gradients to determine the atmospheric movements; the position of the isobars and 'Highs' and 'Lows' being unknown. We have simply the record of the vertical movement of pressure at one point. The isobars on the Weather Map are drawn at intervals of one-tenth inch difference of pressure. The normal to the isobars is called the gradient, and when spoken of, generally refers to the gradient between a 'High' and a 'Low' passing through Ottawa. An examination has been made during the year of the daily seismograms and the daily Weather Maps, including the isobars or position of 'Highs' or 'Lows' and the forecast for the Ottawa regions with reference to winds and storms. This examination furnishes the data upon which the conclusions depend. As the Observatory is not yet supplied with an anemometer and pressure gauge for comparison of the dynamical conditions, we are at present dependent upon the daily forecast.

It may be stated at the outset, before discussing the preceding data, that there is never a day in the year on which some trace of microseisms can not be seen on a seismogram from a Bosch photographic seismograph. It is all a matter of degree. That microseisms should be ever present is but natural, for the earth is in a continual state of stress and strain, many varied and different causes contributing thereto. The term microseisms as here used excludes any deviations of the vertical or movements of the zero position of the pendulum. Some writers have divided microseisms into 'earth tremors' or 'pulsations,' and 'earth pulsations' or 'pulsatory oscillations.' The writer, however, from the seismograms at this station sees no reason for this division, as it is not at all evident from them that the contributory causes, whatever they may be, manifest themselves in such a manner as clearly to differentiate themselves. Furthermore, from the examination of the seismograms the oscillations of the pendulum are excluded; on the one hand, from the frequent change of period on the same seismogram, which would be inadmissible for a pendulum, and on the other hand, if the pendulum were made to oscillate we should expect to see the damping effect in the decrease of amplitude, and a more or less sudden beginning, unless the oscillations of the earth parties themselves were of a period commensurable with that of the pendulum, which, of course, is sometimes the case. It is evident that a photographic registering apparatus with high magnification will record microseisms when a seismograph with mechanical registration will draw only a straight line.

Of the contributing causes to stresses and strains and manifesting themselves as microseisms, we may consider: secular cooling of the earth; unequal heating and the radiation during the day and night; statical effect of atmospheric pressure, areal or local; dynamical effect of atmospheric pressure, areal or local; precipitation, as rain or snow.

The vanishingly small effect of secular cooling, whatever its constants may be, becomes evident from the fact, that, although it is ever present, and its manifestations would be of a constant nature, the recorded microseisms are of the most fluctuating character both in time and magnitude, completely masking the effect of secular cooling. The daily alternations of unequal heating and radiation during the 24 hours are not shown by their effect on microseisms. The case of precipitation is similar in regard to microseisms to the preceding. It may be noted that the stresses set up over large areas, hundreds of miles in extent, by differential loading of rain, is small compared with that of barometric pressure. Taking an area, say of a thousand miles with a rainfall of an inch, which is a pretty heavy rain, and decreasingly distributed, we would have a maximum pressure of a little over one-thirtieth of a pound per square inch, and the rain-pressure diminishing to zero for the edge of the

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area. An average barometric gradient, on the other hand, over such an area would be several times as great, due to a differential atmospheric pressure equivalent to about three-tenths of an inch of the mercurial barometer. The rain-pressure may, however, make itself felt locally, as has been recorded at some stations. The result of a heavy rainfall soon fills the valleys and streams much beyond the direct precipitation on them, so that this loading and bending of the surface may become a measurable quantity by an observing station in the neighbourhood. This effect is, however, one of tilting, of change of vertical or change of pendulum zero and not microseisms, the subject at the moment under discussion.

The effect of difference of atmospheric pressure and of change of atmospheric pressure may be manifested in two ways by the seismograph. We are here dealing with large areas, say 1,000 miles in extent, for local barometric conditions have little or nothing in common with microseisms. In the one case, considering the earth as having an elastic crust, the pier is tilted towards the area of greatest pressure, in consequence of which the pendulum will move in that direction, *i.e.*, its zero line will be displaced. Besides this effect of statical loading, there appears to be no doubt, based on the records here, that vibrations are set up by this statical loading, quite apart from the dynamical effect of change of pressure. In the other case, by change of pressure over a wide area vibrations are set up on the earth's surface, and these may be produced by two allied causes. The one of these is the passage of 'Highs' and 'Lows' over the surface, equivalent to the dragging of a weighted meniscus over the surface, and the other is the winds set up or resulting from the atmospheric gradient due to difference of pressure. The winds would operate more probably by frictional resistance along the surface of the earth rather than by impact or uneven surface or obstructions. In studying various phenomena collectively in an investigation for correlation, considerable restraint must be exercised not to draw conclusions as to cause and effect from a limited number of coincidences, for a conclusion once drawn is apt to become an obsession to the investigator, and he is more or less blinded to facts that do not fit his theory.

In examining the records of microseisms the first question that presents itself is whether the recorded motion is that of the ground or of the pendulum; in the first case the pendulum acts as a steady mass or point, while in the latter case it is set oscillating either by impulses from the ground or by an undulatory movement of the ground. Let us consider the case of microseismic record of the 'sawtooth' type, where we see regular and almost wholly uniform oscillations kept up for hours and longer. If in this case the pendulum actually oscillates it will do so with the period inherent to it. After receiving the first impulse or impact let us suppose it to oscillate. If no further impact were received the oscillations would soon die out and the amplitudes would decrease in the known ratio of the damping coefficient. When a second impulse is given the pendulum will continue its uniform swings, provided the time interval from the preceding impulse is that of the period of the pendulum or a multiple thereof. Were this not the case, interference would occur and would be shown on the record. But such interference is not present in the microseismic records referred to and we must conclude, even admitting that the diagram is a record of the oscillations of the pendulum, that it is in reality only a counterpart of the actual movements of the ground, that is, of horizontal to-and-fro motions of the earth particles. The pendulum can be kept swinging uniformly only by some force acting at intervals of the period of the pendulum. This may occur through the periodic oscillating movements of the earth particles; or the same effect may be produced by rhythmic undulatory movements of the ground. Now, the period of microseisms recorded here lies usually between 5 and 6 seconds, which is also approximately the period of the two pendulums, and the period of the undulatory movements manifested in the 'principal portion' of tectonic earthquakes is 20 seconds or more, so that if we adopt the hypothesis that the microseismic motions are undulatory and not horizontal displacements, we have to explain

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a period only one-quarter of the general period of the earth's crust. The shorter period might perhaps be accounted for by the supposition that a thinner part of the crust of the earth is affected in the microseisms than is involved in the undulatory motion connected with macroseisms. As an analogy we may give the short period of the ripples in water from a breeze, and the much longer one of waves from a storm when a greater depth of water is involved in the motion.

This reasoning does not appear to furnish a conclusive reply to the question whether the microseisms are attributable to the horizontal or to the undulatory movements. However, the consideration of the simultaneous occurrence of microseisms, together with certain atmospheric or barometric conditions leads to the conclusion that microseisms are mostly attributable to horizontal displacements.

Having made daily comparisons with the seismograms, local barograms and weather maps, the following conclusions have been deduced:—It is believed that identical atmospheric conditions prevailing over different parts of the earth's surface will not necessarily produce similar microseisms, as these are affected by the elasticity of the particular area under consideration, also by the geological formation, the presence of well-marked dykes, faults, and by the proximity of large sheets of water or the ocean. One effect of the proximity of the ocean caused by barometric pressure is the change of the level of the water, quite apart from the tides, and this change through loading or unloading along the coast produces a displacement of the pendulum zero, referred to in another place. In the sea, then, we have the dual effect of the direct barometric pressure and the correlated one of displacement of the water, while on land we have only the former. Barometric gradients over the ocean necessarily produce a motion of the water, quite apart from that produced by the winds resulting from the gradients. However, the pressure effect on the ocean bottom remains constant, for any displacement of the water is exactly balanced by the change of atmospheric pressure. Different of course it is on land which suffers the change of barometric pressure.

The feature to strike one most in the above comparisons is that when marked microseisms are present we are almost certain to find that the daily weather map for the morning of the day of record gives for the following 24 hours an area of 'Low' about the Gulf of St. Lawrence. That is, the condition of 'Low' in the gulf precedes the record of marked microseisms. The greater part of the gulf is less than 150 fathoms deep. Through it runs a 'deep' from the mouth of the St. Lawrence (Matane) along the south of Anticosti, passing between Cape Breton and Newfoundland, reaching a depth of 250 fathoms before joining the Atlantic ocean. This deep is over the eastern part of the great St. Lawrence and Champlain Fault, shown on the geological maps, for nearly 700 miles. The waters about Nova Scotia and Newfoundland are all within the 150 fathom line, so that the 'Lows' over the gulf and Sable island are over waters, the greater part of which are less than 150 fathoms deep. The distance from Ottawa to the gulf is about 700 miles, direction east-north-east; and from Ottawa to the nearest broad waters of the Atlantic, off the state of Maine, 300 miles, direction east-south-east.

Next to the presence of a 'Low' in the gulf in importance as a phenomenon accompanying microseisms, we find the isobars which cut the valley of the St. Lawrence (in which lies the great fault) at right angles, so that the gradient is along the St. Lawrence valley, or in general parallel to the Atlantic coast, and to the line of the Alleghany mountains.

Furthermore, it is found that if a 'High' prevails along the south Atlantic coast, northward from Florida the microseisms are intensified.

The passing of 'Highs' and 'Lows' across the coast-line, *i.e.* from land to water, is not found to be marked by the occurrence of microseisms. As the whole atmospheric movement is, for Canada and the United States, from west to east, it is uncommon for a 'High' or 'Low' to cross the coast-line from the Atlantic to the continent.

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It appears that the reversal of the position of 'Low' and 'High' with reference to the gulf for the former is not so closely associated with the subsequent appearance of microseisms as obtains in the case first stated.

When there is a persistence of 'Low' in the gulf and 'High' on the Atlantic coast to the south as indicated, the microseisms set up in the first instance become intensified in amplitude, so that the maximum microseisms are not necessarily coincident with the greatest difference of pressure, or the steepest gradients. It appears that the difference of barometric pressure is in the first instance responsible for the microseisms, and when favourable conditions continue the microseisms will increase in amplitude, although the pressure difference may have decreased. Furthermore, another condition is that the line of 'High'-'Low' preserves its direction along the St. Lawrence valley.

When a 'Low' with even very steep gradients is to the west, say over the lakes, and 'High' on the lower St. Lawrence or gulf, microseisms are generally weak or even absent altogether, although there are exceptions. This is not the case when the 'Low' is to the east, especially when over the gulf. When the 'Low' with steep gradients moves up to Lake Erie by 8 a.m. of the day of the seismogram we may expect to see the beginning of marked microseisms, which increase as the 'Low' moves down the St. Lawrence towards the gulf. From the immediately preceding it is seen that the microseisms give no indication of the approach of a 'Low' or storm centre, but on the contrary, are the result of the passage of a 'Low' and especially of its presence in the gulf. Some investigators believe the microseisms may be the forerunner of coming weather conditions, and hope that this may assist in making forecasts. The seismograms examined here are not very encouraging on that point, the microseisms indicating rather 'that we have had weather, than that we are going to have weather.'

The preceding remarks refer to the microseisms and not to the effect of bending or displacement of the pendulum zero, brought about by unequal pressure over a large area. The writer is not as yet prepared to say whether the approach of a 'Low,' with the consequent lifting or rising of the earth's surface, is a distinctly measurable quantity as registered by our seismograph, for the measurements of the two components of the change of pendulum zero for the year have not yet been tabulated and critically compared with the movements of 'Highs' and 'Lows' in the eastern part of the continent.

By far the large majority of microseisms show themselves by a serrated record, 'sawtooth' type, as I designate them; more rarely are they of the 'spindle' type, where the oscillations or rather the amplitudes rise and fall, increase and decrease, with certain cadence, as in the vibrations of a string between two fixed points. The interval between the maximum amplitudes is very variable, varying from one to several minutes. The rate of increase and decrease of the amplitudes is less than that produced by the damping of the pendulum, so that we can scarcely attribute it to the latter on the supposition that the pendulum itself is set in motion and the oscillation dies down by damping, to be renewed by a fresh impulse. This, however, would preclude a gentle increase: instead there should be a more or less abrupt beginning, which is not the case. Intermittent rhythmic vibrations of the ground, nearly synchronizing with the period of the pendulum, setting the pendulum in motion could produce the phenomenon.

The validity of a supposed relationship between different phenomena, as cause and effect, is tested by predicting the effect when given the cause. This has been done with reference to the existence of a 'Low' in the gulf and a 'High' over the Atlantic coast to the south, or in general by taking the daily weather map with its isobars and from it predicting the resulting microseisms. The result has so far been satisfactory that in the large majority of cases the microseisms have fairly well answered in presence and magnitude the prediction. There are, however, still important out-

standing differences that require further explanation. Just why the 'Low' about the gulf should have such an influence in the production of microseisms is by no means apparent. The two main physical features are the shallow gulf and the St. Lawrence valley in which lies the great St. Lawrence and Champlain Fault, 700 miles long, already referred to. Also there is the generally parallel trend of the Atlantic coast, and that of the Alleghany mountains.

On frequent occasions there is a 'Low' over the gulf, another 'Low' over Arkansas, while one 'High' rests north of Lake Superior and another over Bermuda. When these conditions obtain with steep gradients we are pretty sure to have marked microseisms. The line joining the 'Lows,' then, lies in the St. Lawrence valley, while that of the 'Highs' is at right angles to the former. In this case the maximum strain is along the valley of the St. Lawrence, along the Great Fault, so that from *a priori* reasoning marked microseisms might be expected.

In concluding the present investigation of the well-marked microseisms recorded here, we will repeat, that the presence of a 'Low' over the gulf surrounded by steep or fairly steep gradients on a given morning is indicative of more or less well-marked microseisms following at Ottawa that day.

It has already been stated that the large majority of microseisms have a period of about 5<sup>s</sup> with small fluctuations. The cause of the fluctuations is by no means apparent unless it be the varying depth of the earth's surface involved.

On some occasions the period changes to one of about one-half, or about 3<sup>s</sup>, showing, however, a transition time during which there is an irregularity and interference, so that their period is unrecognizable. At present no explanation can be offered for this change. When the period is so short, the amplitudes are very minute, although visible on the sheet to the naked eye.

It is found that, broadly speaking, the microseisms are more numerous during the colder season than during the warmer one, and some have sought therein a relationship of cause and effect. In our climate here we have a large range of temperature, during the year 1907-1908, of 127°F. (96° and - 31°F.). During February, when the thermometer reached its lowest and we had some continuously very cold weather, the seismograph showed no evidence thereof. More frequent microseisms might be expected during winter from the fact that the frozen ground better transmits pulsations, and that the act of freezing itself sets up stresses and consequent oscillations. From extreme cold it does not necessarily follow that the ground is frozen to any great depth. During the past winter there was very little frost in the ground, because an early and heavy snowfall, subsequently accumulating to many feet, covered the earth with a mantle that cold could not penetrate.

From examination it is found that the strongest and most numerous microseisms were recorded during the months of January and February last (1909), while during the period September, 1907, to April, 1908, October had the strongest, and the fewest and weakest were during the summer months of July and August, when the atmospheric barometric gradients were very long.

We are led to conclude that strong winds have little effect in causing microseisms by setting up pulsations over large areas of the earth's surface or crust, *i.e.*, the dynamical effect by friction or impact is not the governing factor in the production of microseisms. We are dealing here with the larger effect of strong winds upon large areas and not the local effect upon buildings, which, as is well known, are set in oscillation, and these in turn are communicated to the ground. When the building within which the seismograph is housed is large, the oscillations of the former will be recorded.

When we compare the occurrence of microseisms with the predicted strong winds of the daily forecasts, we find little or no connection between the two phenomena. Considering the two phenomena as independent events, we see that the probability of the simultaneous occurrence of the two events is as great as the actual happening.

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*i.e.*, as far as the observations go there is very little to show any causal relationship between the two.

On the other hand we do find that the winds recorded here by the micro-barograph invariably show themselves on the seismograms, not by microseisms, but by irregular movements, including deviations of the zero line. Microseisms and these latter movements can never be mistaken for earthquake records.

RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10. a.m. Standard Time = 15<sup>h</sup> G.M.T.

| Date.       | N-S. COMP. |           | E-W. COMP. |           | REMARKS.  |
|-------------|------------|-----------|------------|-----------|---|
|             | Period.    | Max. Amp. | Period.    | Max. Amp. |   |
| 1908.       | s.         | $\mu$     | s.         | $\mu$     | —   |
| Jan. 1..... | 5.7        | 8         | 5.8        | 8         | Decreasing towards following morning.                                   |
| " 2.....    |            |           |            |           | Almost wholly quiescent.  |
| " 3.....    |            |           |            |           | Almost quiescent. *   |
| " 4.....    |            |           |            |           | " "   |
| " 5.....    | 5.5        | 7         | 5.4        | 8         | Increase gradually, reach a maximum about midnight, then decrease.      |
| " 6.....    | 5.5        | 4         | 5.5        | 4         |   |
| " 7.....    | 5.5        | 4         | 5.5        | 4         | Maximum about 8 a. m., Jan. 8.  |
| " 8.....    | 5.5        | 4         | 5.5        | 4         |   |
| " 9.....    | 5.5        | 4         | 5.5        | 4         |   |
| " 10.....   | 5.6        |           | 5.6        |           | Small.  |
| " 11.....   | 5.5        | 2         | 5.5        | 2         |   |
| " 12.....   | 5.5        | 4         | 5.5        | 4         |   |
| " 13.....   | 5.5        | 3         | 5.5        | 4         |   |
| " 14.....   | 5.5        | 4         | 5.1        | 4         | Increase about midnight.  |
| " 15.....   |            |           |            |           | Present but weak.   |
| " 16.....   |            |           |            |           | Slight microseisms scattered throughout.                                |
| " 17.....   |            | 2         |            | 2         |   |
| " 18.....   |            |           |            |           | Scarcely any.   |
| " 19.....   |            |           |            |           | " "   |
| " 20.....   | 5.5        | 2         | 5.5        | 2         |   |
| " 21.....   | 5.5        | 2         | 5.5        | 2         |   |
| " 22.....   | 3.0        |           |            |           |   |
| " 23.....   | 5.3        | 4         | 5.5        | 4         |   |
| " 24.....   | 5.5        | 7         | 5.5        | 7         | Two hours at beginning and end of sheet weakest.                        |
| " 25.....   | 5.5        |           | 5.7        |           | Decreasing.   |
| " 26.....   |            |           |            |           | Small, of usual saw-tooth type, not so well expressed by N-S component. |
| " 27.....   | 5.5        | 4         | 5.5        | 4         |   |
| " 28.....   |            |           |            |           | Present throughout.   |
| " 29.....   |            |           |            |           | " "   |
| " 30.....   |            | 2         |            | 2         |   |
| " 31.....   |            |           |            |           | Slight throughout.  |
| Feb. 1..... |            | 6         |            | 6         | Earthquake occurs, microseisms after quake.                             |
| " 2.....    | 5.7        | 6         | 6.3        | 6         |   |
| " 3.....    |            |           |            |           | Not so strong as yesterday.   |
| " 4.....    |            |           |            |           | Scarcely any.   |
| " 5.....    |            |           |            |           | Weak.   |
| " 6.....    |            |           |            |           | " "   |
| " 7.....    | 5.5        | 2         | 6.0        | 2         |   |
| " 8.....    |            |           |            |           | Small.  |
| " 9.....    |            |           |            |           | Very slight.  |
| " 10.....   |            |           |            |           | Scarcely any.   |
| " 11.....   |            |           |            |           | " "   |
| " 12.....   |            |           |            |           | Very few and weak.  |
| " 13.....   |            |           |            |           | Small and fairly evenly distributed.                                    |
| " 14.....   |            |           |            |           | Very few.   |
| " 15.....   | 5.4        | 3         | 6.3        | 4         |   |
| " 16.....   | 5.3        | 3         | 6.6        | 5         |   |
| " 17.....   | 5.5        | 3         | 6.3        | 3         |   |
| " 18.....   |            |           |            |           | Scarcely any.   |

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RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.    | N-S COMP. |           | E-W. COMP. |           | REMARKS.   |
|----------|-----------|-----------|------------|-----------|--|
|          | Period.   | Max. Amp. | Period.    | Max. Amp. |  |
| 1908.    | S.        | a         | S.         | a         |  |
| Feb. 19. |           |           |            |           | Very minute, increase after 3 a. m.                                    |
| " 20.    | 5.7       |           | 6.4        | 4         | Fairly strong by E.-W. component.                                      |
| " 21.    | 6.0       |           | 6.8        | 6         |  |
| " 22.    | 6.0       | 3         | 6.5        | 4         |  |
| " 23.    |           |           |            |           | Very weak.   |
| " 24.    |           |           |            |           | Weak.  |
| " 25.    |           |           |            |           | Practically quiescent.   |
| " 26.    |           |           |            |           | Very minute.   |
| " 27.    |           |           |            |           | Small.   |
| " 28.    |           |           |            |           | Very weak.   |
| " 29.    |           |           |            |           | Slight traces.   |
| March 1. |           |           |            |           | " "  |
| " 2.     |           |           |            |           | Very slight traces.  |
| " 3.     | 3.0       |           | 3.0        |           | Very weak.   |
| " 4.     |           |           |            |           | Apparently quiescent.  |
| " 5.     |           |           |            |           | Almost perfectly quiescent.  |
| " 6.     | 5.5       | 3         | 6.0        | 5         | Decrease after 6 p.m.  |
| " 7.     |           |           |            |           | Very slight.   |
| " 8.     |           |           |            |           | " "  |
| " 9.     |           |           |            |           | Almost quiescent till about 3 a.m., when micros. set in, reading 3a.   |
| " 10.    | 5.7       | 1         | 6.9        | 4         |  |
| " 11.    |           | 1         |            | 2         |  |
| " 12.    |           | 1         |            | 1         |  |
| " 13.    |           |           |            |           | Very slight.   |
| " 14.    |           |           |            |           | " "  |
| " 15.    |           |           |            |           | " "  |
| " 16.    |           |           |            |           | Practically quiescent.   |
| " 17.    |           |           |            |           | Quiescent.   |
| " 18.    |           |           |            |           | Very minute.   |
| " 19.    |           |           |            |           | " "  |
| " 20.    |           |           |            |           | Minute.  |
| " 21.    | 5.7       | 2         | 6.3        | 2         | Small.   |
| " 22.    |           |           |            |           | Very slight.   |
| " 23.    |           |           |            |           | " "  |
| " 24.    |           |           |            |           | Small.   |
| " 25.    |           | 4         |            | 4         | Decrease after 7 p.m.  |
| " 26.    |           |           |            |           | Small. Continue between the two earthquake records of Chilapa, Mexico. |
| " 27.    |           |           |            |           | Very minute.   |
| " 28.    |           | 2         |            | 2         | Minute.  |
| " 29.    |           |           |            |           | " "  |
| " 30.    | 4.0       | 2         |            |           |  |
| " 31.    |           |           |            | 3         | Strongest during night.  |
| April 1. | 4.6       | 4         | 4.8        | 2         | Increase after 6 p.m.  |
| " 2.     |           |           |            |           | Less strong.   |
| " 3.     | 5.2       | 5         | 5.0        | 5         |  |
| " 4.     | 5.7       | 6         | 7.5        | 6         |  |
| " 5.     |           | 3         |            | 3         | Gradually decreasing.  |
| " 6.     |           |           |            |           | Minute.  |
| " 7.     |           |           |            |           | Very minute.   |
| " 8.     |           |           |            |           | Minute.  |
| " 9.     | 3.5       | 2         | 3.5        | 2         |  |
| " 10.    | 5.2       | 4         | 6.3        | 2         |  |
| " 11.    | 5.5       | 4         | 5.0        | 3         |  |
| " 12.    | 5.7       | 6         | 6.2        | 4         |  |
| " 13.    | 5.7       | 7         | 6.0        | 5         |  |
| " 14.    | 5.3       | 4         | 6.0        | 3         | Decreasing.  |
| " 15.    | 5.3       |           | 7.5        |           | By following morning period for both 3:7.                              |
| " 16.    | 4.2       | 3         | 4.1        | 2         | Decrease.  |
| " 17.    | 5.5       | 4         | 5.5        | 4         |  |
| " 18.    | 6.0       | 4         | 7.3        | 5         |  |



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RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 am. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.        | N-S. Comp. |           | E W. Comp. |           | REMARKS.   |
|--------------|------------|-----------|------------|-----------|--|
|              | Period.    | Max. Amp. | Period.    | Max. Amp. |  |
| 1908.        | S.         | $\mu$     | S.         | $\mu$     |  |
| Apr. 19..... |            |           |            |           | Minute, increase after 6 a.m.                                      |
| " 20.....    |            | 4         |            | 3         |  |
| " 21.....    | 5.3        | 4         | 5.4        | 3         |  |
| " 22.....    | 5.2        | 3         | 5.7        | 2         |  |
| " 23.....    | 5.5        |           | 5.5        |           | Very minute, and decreasing.                                       |
| " 24.....    | 5.0        | 2         | 5.0        | 2         | Quiescent after noon.  |
| " 25.....    |            |           |            |           | Almost quiescent.  |
| " 26.....    |            | 1         |            | 1         | Small.   |
| " 27.....    |            | 2         |            | 2         | Stronger after 6 a. m.   |
| " 28.....    | 6.3        | 4         | 7.5        | 5         |  |
| " 29.....    | 6.6        | 5         | 7.5        | 6         |  |
| " 30.....    |            | 2         |            | 3         |  |
| May 1.....   |            | 2         |            | 2         |  |
| " 2.....     | 5.3        | 3         | 6.0        | 2         |  |
| " 3.....     | 5.3        | 5         | 6.3        | 4         |  |
| " 4.....     |            | 5         |            | 4         | Strongest during night.  |
| " 5.....     | 5.7        | 6         | 6.0        | 5         | Decrease after 1 a. m.   |
| " 6.....     | 5.5        | 2         | 6.0        | 2         |  |
| " 7.....     | 5.5        | 3         | 6.0        | 2         |  |
| " 8.....     | 4.3        |           | 5.0        |           | Minute.  |
| " 9.....     | 5.5        | 3         | 6.0        | 2         |  |
| " 10.....    | 5.5        | 4         | 5.7        | 3         |  |
| " 11.....    |            | 2         |            | 1         | Decreasing.  |
| " 12.....    | 3.5        | 1         | 7.0        | 4         |  |
| " 13.....    | 4.0        |           |            |           | Very minute.   |
| " 14.....    | 4.3        |           |            |           | "  |
| " 15.....    |            |           |            |           | "  |
| " 16.....    | 5.2        | 1         |            |           | Very small.  |
| " 17.....    |            |           |            |           | Almost quiescent.  |
| " 18.....    |            |           |            |           | " "  |
| " 19.....    |            |           |            |           | " "  |
| " 20.....    |            |           |            |           | " "  |
| " 21.....    |            |           |            |           | Almost wholly quiescent.   |
| " 22.....    |            |           |            |           | Practically quiescent.   |
| " 23.....    |            |           | 7.0        |           | Almost quiescent.  |
| " 24.....    |            |           |            |           | Quiescent.   |
| " 25.....    |            |           |            |           | Almost quiescent.  |
| " 26.....    |            |           |            |           | Quiescent.   |
| " 27.....    |            |           |            |           | Slight traces.   |
| " 28.....    |            |           |            |           | Quiescent.   |
| " 29.....    | 2.7        |           | 4.6        |           | Very minute.   |
| " 30.....    | 2.7        |           | 4.3        |           | "  |
| " 31.....    |            |           |            |           | Apparently quiescent, but shows very minute and rapid oscillations |
| June 1.....  |            |           |            |           | " " " "  |
| " 2.....     |            |           |            |           | Practically quiescent.   |
| " 3.....     |            |           | 7.0        | 2         |  |
| " 4.....     |            |           |            |           | Very small.  |
| " 5.....     |            |           |            |           | Practically quiescent.   |
| " 6.....     |            |           |            |           | " "  |
| " 7.....     |            |           |            |           | Faintest traces.   |
| " 8.....     |            |           |            |           | "  |
| " 9.....     |            |           |            |           | "  |
| " 10.....    |            |           |            |           | Practically quiescent.   |
| " 11.....    |            |           |            |           | Perfectly quiescent.   |
| " 12.....    |            |           |            |           | Quiescent.   |
| " 13.....    |            |           |            |           | Practically quiescent.   |
| " 14.....    |            |           |            |           | Quiescent.   |
| " 15.....    |            |           |            |           | Small, scattered.  |
| " 16.....    |            |           |            |           | Small.   |
| " 17.....    |            |           |            |           | Very minute.   |
| " 18.....    | 5.5        | 1         |            |           | Decrease after midnight.   |

RECORD of Micro-eisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>b</sup> G.M.T.—*Con.*

| Date.    | N-S. COMP. |           | E-W. COMP. |           | REMARKS.  |
|----------|------------|-----------|------------|-----------|---|
|          | Period.    | Max. Amp. | Period.    | Max. Amp. |   |
| 1908.    | S.         | $\mu$     | S.         | $\mu$     |   |
| June 19. |            |           |            |           | Small.  |
| " 20.    |            |           |            |           | Nearly quiescent.   |
| " 21.    |            |           |            |           | Very minute.  |
| " 22.    |            |           |            |           | A few very minute shown by N-S component.   |
| " 23.    |            |           |            |           | A few scattered shown by N-S component.   |
| " 24.    | 4 4        | 1         |            |           | Strongest about 4 p. m.   |
| " 25.    |            |           |            |           | Practically quiescent.  |
| " 26.    |            |           |            |           | " "   |
| " 27.    |            |           |            |           | " "   |
| " 28.    |            |           |            |           | Practically quiescent.  |
| " 29.    |            |           |            |           | " "   |
| " 30.    |            |           |            |           | Very minute by N-S component.   |
| July 1.  |            |           |            |           | Practically quiescent.  |
| " 2.     |            |           |            |           | " "   |
| " 3.     |            |           |            |           | Quiescent.  |
| " 4.     |            |           |            |           | "   |
| " 5.     |            |           |            |           | Minute.   |
| " 6.     |            |           |            |           | Quiescent.  |
| " 7.     |            |           |            |           | Almost quiescent, some minute between 2 and 4 a.m. (July 8).  |
| " 8.     |            |           |            |           | Quiescent.  |
| " 9.     |            |           |            |           | Very minute, mostly shown by N-S component.   |
| " 10.    |            |           |            |           | Practically quiescent.  |
| " 11.    |            |           |            |           | Quiescent.  |
| " 12.    |            |           |            |           | "   |
| " 13.    |            |           |            |           | "   |
| " 14.    |            |           |            |           | "   |
| " 15.    |            |           |            |           | "   |
| " 16.    |            |           |            |           | " , a few very minute.  |
| " 17.    |            |           |            |           | Very minute throughout, more distinct by N-S component.   |
| " 18.    |            |           |            |           | Very minute.  |
| " 19.    |            |           |            |           | Practically quiescent.  |
| " 20.    |            |           |            |           | Quiescent.  |
| " 21.    |            |           |            |           | "   |
| " 22.    |            |           |            |           | "   |
| " 23.    |            |           |            |           | "   |
| " 24.    |            |           |            |           | "   |
| " 25.    |            |           |            |           | " until about 8 a. m. (July 26) when minute micros. appear and increase.  |
| " 26.    | 5 2        | 4         | 5 2        | 4         | First typical "sawtooth" micros. for months. Strongest between 9 p.m. and 3 a.m. Period N-S component pendulum 6.1, E-W component pendulum 10" 1. |
| " 27.    | 5 5        | 3         | 6 0        | 3         | Decrease, disappear after 12 p.m.   |
| " 28.    |            |           |            |           | Practically quiescent.  |
| " 29.    |            |           |            |           | Quiescent.  |
| " 30.    |            | 1         |            | 1         | Very minute.  |
| " 31.    |            |           |            |           | Almost quiescent.   |
| Aug. 1.  | 5 0        | 4         | 5 0        | 4         | Low moving up Atlantic coast from Hatteras.   |
| " 2.     | 5 0        | 4         | 5 0        | 4         | Little stronger than yesterday. Maximum about midnight.   |
| " 3.     | 5 0        | 3         | 5 0        | 3         |   |
| " 4.     |            | 2         |            | 2         |   |
| " 5.     |            |           |            |           | Practically quiescent.  |
| " 6.     |            |           |            |           | Quiescent   |
| " 7.     |            |           |            |           | "   |
| " 8.     |            |           |            |           | "   |
| " 9.     |            | 1         |            | 1         | Very minute.  |
| " 10.    |            |           |            |           | "   |
| " 11.    |            |           |            |           | " , shown best by N-S. component.   |

## SESSIONAL PAPER No. 25a

RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.   | N. S. Comp. |           | E. W. Comp. |           | REMARKS.  |
|---------|-------------|-----------|-------------|-----------|---|
|         | Period.     | Max. Amp. | Period.     | Max. Amp. |   |
| 1908.   | s.          | $\mu$     | s.          | $\mu$     |   |
| Aug. 12 |             |           |             |           | Practically quiescent.  |
| " 13    |             |           |             |           | Quiescent.  |
| " 14    |             |           |             |           | "   |
| " 15    |             | 1         |             | 1         | "   |
| " 16    |             | 1         |             | 1         | Not continuous.   |
| " 17    |             |           |             |           | Almost quiescent.   |
| " 18    | 4.5         |           |             |           | Very minute.  |
| " 19    |             |           |             |           | "   |
| " 20    |             | 1         |             | 1         | "   |
| " 21    |             | 2         |             | 2         | "   |
| " 22    |             | 2         |             | 2         | Strongest in forenoon.  |
| " 23    |             | 2         |             | 2         | " about 3 a.m. (Aug. 24).   |
| " 24    |             |           |             |           | Very small.   |
| " 25    |             |           |             |           | Minute.   |
| " 26    | 3.7         | 1         | 3.7         | 1         | Quiescent till about 2 a.m. (Aug. 27), then small.                              |
| " 27    | 5.1         | 5         | 5.1         | 4         | Low moving up Atlantic coast from Hatteras.                                     |
| " 28    | 5.0         | 1         | 5.0         | 1         | Decrease after 8 p.m.   |
| " 29    |             |           |             |           | Very minute, and decrease.  |
| " 30    |             |           |             |           | Practically quiescent.  |
| " 31    |             |           |             |           | " "   |
| Sep. 1  |             |           |             |           | Almost quiescent.   |
| " 2     | 3.8         | 1         | 3.8         | 1         | Minute.   |
| " 3     | 5.0         |           | 5.0         |           | A little stronger than yesterday.   |
| " 4     |             |           |             |           | Practically quiescent.  |
| " 5     |             |           |             |           | " "   |
| " 6     |             |           |             |           | Practically quiescent, save for fluctuations, not micros. caused by gusty wind. |
| " 7     | 5.5         | 2         | 6.0         | 1         |   |
| " 8     | 5.0         |           | 5.0         |           |   |
| " 9     | 5.0         | 1         | 5.0         | 1         | Decreasing after midnight.  |
| " 10    | 5.0         | 1         | 5.0         | 1         |   |
| " 11    | 5.0         |           | 5.0         |           | Very small.   |
| " 12    | 6.0         | 1         | 7.5         | 2         | Towards evening micros. appear, increase to midnight, then decrease.            |
| " 13    |             |           |             |           | Minute.   |
| " 14    | 4.7         | 1         | 4.9         | 1         | Minute, increase.   |
| " 15    | 5.5         | 2         | 5.5         | 2         |   |
| " 16    | 5.6         | 3         | 6.4         | 4         | Maximum about 10 p.m.   |
| " 17    | 4.5         | 2         | 5.8         | 3         |   |
| " 18    | 5.7         | 3         | 6.3         | 4         |   |
| " 19    | 5.9         | 4         | 6.6         | 5         |   |
| " 20    | 4.7         | 3         | 5.5         | 4         |   |
| " 21    | 5.4         | 2         | 6.8         | 3         |   |
| " 22    | 6.1         | 1         | 6.8         | 2         |   |
| " 23    | 5.0         | 1         | 5.7         | 1         |   |
| " 24    |             |           | 7.5         | 1         | Almost wholly quiescent, here and there micros.                                 |
| " 25    |             |           | 7.0         | 1         |   |
| " 26    | 5.6         | 1         | 7.5         | 1         |   |
| " 27    | 5.5         |           | 5.7         |           | Small; N-S component the stronger, being reverse of what it has been lately.    |
| " 28    | 5.5         | 1         | 5.7         | 1         |   |
| " 29    | 5.0         | 2         | 5.0         | 1         |   |
| " 30    | 5.1         | 2         | 6.2         | 1         |   |
| Oct. 1  | 5.3         | 1         | 5.1         | 1         |   |
| " 2     | 4.0         | 1         | 4-10        | 3         | After 1 a.m. (Oct. 3) periods lengthen, and intensity increases.                |
| " 3     | 4.5         | 4         | 7.5 4.7     | 4         | Increase after 9 p.m. Period of E-W component becomes shorter.                  |
| " 4     | 5.3         | 3         | 5.5         | 2         | Decreasing.   |
| " 5     | 5.4         | 2         | 5.5         | 1         |   |
| " 6     |             |           |             |           | Minute.   |

RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.  | N-S. COMP. |           | E-W. COMP. |           | REMARKS.  |
|--------|------------|-----------|------------|-----------|---|
|        | Period.    | Max. Amp. | Period.    | Max. Amp. |   |
| 1908.  | s.         | $\mu$     | s.         | $\mu$     |   |
| Oct. 7 | 4.9        | 1         | 4.9        | 1         |   |
| " 8    | 4.8        | 2         | 5.1        | 2         | Strongest about 8 p.m.  |
| " 9    | 5.2        | 2         | 5.4        | 2         | Strongest about midnight.   |
| " 10   | 5.3        | 2         | 5.8        | 2         | Strongest between 8 p.m. and 2 a.m.   |
| " 11   | 4.6        |           | 5.0        |           | Very small, better expressed by N-S component.  |
| " 12   |            |           |            |           | Small and well marked.  |
| " 13   | 5.3        | 2         | 5.2        | 2         |   |
| " 14   | 5.6        | 3         | 5.7        | 3         | Strongest about 9 p.m.  |
| " 15   | 5.2        | 1         | 6.8        | 1         | Almost disappear by following morning.  |
| " 16   |            |           |            |           | Almost quiescent.   |
| " 17   | 6.4        | 1         | 6.7        | 2         | Almost quiescent till about 9 p.m. then become pretty well marked.                        |
| " 18   | 6.5        | 1         | 7.0        | 1         |   |
| " 19   |            |           |            |           | Very minute.  |
| " 20   | 4.9        | 1         | 6.7        | 1         | Almost quiescent.   |
| " 21   | 6.0        | 3         | 6.6        | 4         | Minute till 9 p.m., then increase.  |
| " 22   | 6.3        | 3         | 6.8        | 5         | Decrease after 8 p.m.   |
| " 23   | 5.1        | 1         | 7.8        | 1         |   |
| " 24   | 5.1        | 2         | 6.9        | 2         |   |
| " 25   | 5.4        | 2         | 5.5        | 2         |   |
| " 26   | 5.3        | 1         | 5.6        | 1         | Decrease after 2 a.m., (Oct. 27).   |
| " 27   | 5.4        | 1         | 6.1        | 1         |   |
| " 28   | 5.1        | 1         | 6.0        | 1         | Scattered throughout, not continuous.   |
| " 29   | 4.6        | 4         | 4.3        | 3         | Increase after 2 a.m., (Oct. 30).   |
| " 30   | 4.7        | 3         | 4.5        | 2         |   |
| " 31   | 5.4        | 6         | 5.4        | 3         | Begin small. After 5 a.m., (Nov. 1st), become very marked.                                |
| Nov. 1 | 5.6        | 6         | 5.8        | 4         | "Sawtooth" type, very few of spindle form.  |
| " 2    | 5.5        | 4         | 5.4        | 3         |   |
| " 3    | 5.4        | 5         | 5.8        | 3         |   |
| " 4    | 5.4        | 4         | 5.5        | 2         |   |
| " 5    | 5.0        | 4         | 4.9        | 2         | Strongest during the night.   |
| " 6    | 5.8        | 10        | 6.6        | 6         |   |
| " 7    | 5.8        | 6         | 5.9        | 4         |   |
| " 8    | 5.7        | 3         | 5.8        | 2         |   |
| " 9    | 5.3        | 2         | 5.3        | 1         |   |
| " 10   | 5.0        | 1         | 5.9        | 1         |   |
| " 11   | 4.8        | 1         | 6.9        | 1         |   |
| " 12   | 4.9        | 5         | 5.4        | 3         | Fairly quiescent till midnight, when micros. set in and increase in intensity.            |
| " 13   | 5.2        | 5         | 5.7        | 4         |   |
| " 14   | 5.4        | 2         | 5.8        | 2         | After 2 a.m., period changes markedly by decreasing to 4.                                 |
| " 15   | 4.8        | 2         | 4.6        | 2         |   |
| " 16   | 4.8        | 3         | 5.3        | 2         |   |
| " 17   | 4.5        | 1         | 5.5        | 1         |   |
| " 18   | 4.8        | 4         | 5.0        | 3         | Increase after 7 p.m.   |
| " 19   | 4.3        | 4         | 4.4        | 3         | Maximum about 7 p.m.  |
| " 20   | 5.0        | 2         | 8.3        | 1         |   |
| " 21   | 5.0        | 2         | 5.0        | 1         |   |
| " 22   | 4.0        | 2         | 4.0        | 1         |   |
| " 23   |            |           |            |           | Scarcely a trace.   |
| " 24   | 5.0        | 1         |            |           | Almost quiescent.   |
| " 25   | 5.0        | 1         |            |           | "   |
| " 26   | 5.7        | 1         | 7.0        | 1         |   |
| " 27   | 5.2        | 2         | 7.2        | 1         |   |
| " 28   | 5.0        | 3         | 5.0        | 2         |   |
| " 29   | 5.6        | 3         | 5.6        | 2         | Decrease.   |
| " 30   | 5.2        | 2         | 5.3        | 1         |   |
| Dec. 1 |            |           |            |           | Very windy, shown by irregularity of zero line.   |
| " 2    | 5.1        | 3         | 4.5        | 3         | New steel point for E-W component.} Begin small, become well-marked by following morning. |

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RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.  | N S. COMP. |           | E W. COMP. |           | REMARKS.   |
|--------|------------|-----------|------------|-----------|--|
|        | Period.    | Max. Amp. | Period.    | Max. Amp. |  |
| 1908.  | s.         | $\mu$     | s.         | $\mu$     |  |
| Dec. 3 | 5.4        | 3         | 4.3        | 4         |  |
| " 4    | 5.1        | 2         | 4.5        | 2         |  |
| " 5    | 5.1        | 3         | 4.5        | 5         | Begin small.   |
| " 6    | 5.1        | 4         | 4.5        | 6         |  |
| " 7    | 5.1        | 3         | 4.3        | 8         |  |
| " 8    | 5.2        | 5         | 4.6        | 9         |  |
| " 9    | 5.1        | 3         | 4.3        | 4         |  |
| " 10   | 5.3        | 3         | 4.6        | 4         |  |
| " 11   | 5.8        | 3         | 4.5        | 4         | Strongest about 7 p.m.   |
| " 12   | 5.6        | 4         | 4.6        | 5         |  |
| " 13   | 5.5        | 5         | 4.4        | 5         |  |
| " 14   | 5.3        | 3         | 4.6        | 5         |  |
| " 15   | 5.6        | 4         | 4.7        | 4         |  |
| " 16   | 5.3        | 3         | 4.6        | 4         |  |
| " 17   | 5.3        | 3         | 4.5        | 5         |  |
| " 18   | 5.1        | 3         | 4.4        | 5         |  |
| " 19   | 5.2        | 3         | 6.5        | 6         |  |
| " 20   | 6.2        | 2         | 6.6        | 5         |  |
| " 21   | 4.9        | 1         | 6.6        | 2         |  |
| " 22   | 5.1        | 1         | 5.6        | 4         |  |
| " 23   | 5.5        | 4         | 6.6        | 7         |  |
| " 24   | 5.6        | 2         | 6.3        | 4         |  |
| " 25   | 5.6        | 1         | 6.3        | 3         |  |
| " 26   | 5.5        | 4         | 6.8        | 7         | Strongest between 5 and 12 p.m.                                      |
| " 27   | 5.4        | 4         | 6.1        | 7         |  |
| " 28   | 5.6        | 4         | 6.2        | 5         | No difference of micros. before and after the earthquake (Messina).  |
| " 29   | 4.3        | 2         | 4.7        | 4         |  |
| " 30   | 5.4        | 1         | 6.4        | 2         |  |
| " 31   |            |           |            |           | Small to minute.   |
| 1909.  |            |           |            |           |  |
| Jan. 1 | 5.5        | 2         | 5.9        | 3         |  |
| " 2    | 5.1        | 1         | 5.8        | 2         |  |
| " 3    | 5.0        | 1         | 5.4        | 1         | Almost quiescent.  |
| " 4    | 5.0        | 1         | 6.3        | 1         | " "  |
| " 5    | 5.3        | 1         | 6.5        | 2         |  |
| " 6    | 5.3        | 2         | 6.0        | 3         | Increasing.  |
| " 7    | 4.9        | 2         | 6.6        | 4         |  |
| " 8    | 4.9        |           | 6.4        | 1         | Almost quiescent.  |
| " 9    |            |           |            |           | " perfectly quiescent.   |
| " 10   | 5.3        | 1         | 6.5        | 2         |  |
| " 11   | 5.0        | 1         | 6.5        | 2         |  |
| " 12   | 5.3        | 1         | 8.6        | 2         |  |
| " 13   | 5.1        | 1         | 6.6        | 2         |  |
| " 14   | 5.4        |           | 6.6        |           | Almost perfectly quiescent.  |
| " 15   | 4.7        | 1         | 5.7        | 2         |  |
| " 16   | 5.3        | 2         | 6.7        | 5         |  |
| " 17   |            |           | 7.0        | 5         | Wind effect shown by irregularities of zero line. N-S component off. |
| " 18   |            |           | 6.6        | 8         | Maximum between 5 and 9 a.m. (January 19). N S component off.        |
| " 19   | 6.0        | 7         | 6.4        | 12        | Strongest in a long time.  |
| " 20   | 5.9        | 4         | 6.9        | 7         |  |
| " 21   | 5.4        | 2         | 6.0        | 3         | Almost cease after 5 p.m.  |
| " 22   | 5.8        | 1         | 6.7        | 1         | Fairly quiescent.  |
| " 23   | 5.7        | 1         | 5.9        | 1         | Scattered, not continuous.   |
| " 24   | 6.0        | 2         | 6.1        | 2         |  |
| " 25   | 6.0        | 1         | 6.0        | 1         | Wind makes zero line irregular.                                      |
| " 26   | 4.5        | 3         | 4.5        | 3         |  |
| " 27   | 5.6        | 5         | 6.5        | 6         |  |

9-10 EDWARD VII., A. 1910

RECORD of Microseisms for the period January 1, 1908, to March 31, 1909. Two Bosch photographic seismographs, mounted N.-S., E.-W. Magnification, 120. Sheet put on each day at about 10 a.m. Standard Time = 15<sup>h</sup> G.M.T.—*Con.*

| Date.   | N.-S. COMP. |           | E.-W. COMP. |           | REMARKS.   |
|---------|-------------|-----------|-------------|-----------|--|
|         | Period.     | Max. Amp. | Period.     | Max. Amp. |  |
| 1909.   | s.          | a.        | s.          | a.        |  |
| Jan. 28 | 5.8         | 5         | 6.8         | 7         |  |
| " 29    | 6.6         | 5         | 6.8         | 8         |  |
| " 30    | 6.6         | 5         | 6.7         | 6         |  |
| " 31    | 5.3         | 2         | 6.6         | 3         |  |
| Feb. 1  | 5.5         | 2         | 6.4         | 4         |  |
| " 2     | 5.4         | 1         | 6.2         | 2         | Decreasing.  |
| " 3     | 5.2         | 1         | 5.8         | 1         | Almost quiescent.  |
| " 4     | 5.2         | 1         | 5.2         | 1         | " "  |
| " 5     | 5.2         | 1         | 5.4         | 1         | Minute.  |
| " 6     | 3.5         | 1         | 4.6         | 1         |  |
| " 7     | 5.1         | 2         | 5.1         | 2         |  |
| " 8     | 5.4         | 5         | 5.6         | 5         | Decrease after 8 p.m.  |
| " 9     | 5.5         | 6         | 6.2         | 8         | Increasing.  |
| " 10    |             |           |             |           | No light.  |
| " 11    | 5.7         | 2         | 6.7         | 2         | Small.   |
| " 12    | 5.4         | 1         | 5.9         | 1         |  |
| " 13    | 4.5         | 1         | 4.5         | 1         | Minute.  |
| " 14    | 4.5         | 1         | 4.5         | 1         | Very small.  |
| " 15    | 6.2         | 1         | 6.8         | 2         | Decreasing.  |
| " 16    | 3.7         | 1         | 3.7         | 1         | Periods decrease after 7 p.m.  |
| " 17    | 4.4         | 2         | 6.6         | 2         |  |
| " 18    | 5.4         | 2         | 6.5         | 3         | Begin small, but increase, particularly after 5 a.m.                                     |
| " 19    | 5.9         | 3         | 6.8         | 5         | (Feb. 19).   |
| " 20    | 5.1         | 2         | 6.4         | 3         |  |
| " 21    | 5.7         | 2         | 6.4         | 4         | In general not as strong as yesterday.   |
| " 22    | 5.7         | 2         | 6.2         | 3         |  |
| " 23    | 5.6         | 1         | 6.2         | 1         | Small.   |
| " 24    | 5.3         | 1         | 6.2         | 1         | Wind effect shown by irregularity of zero line.  |
| " 25    | 5.6         | 5         | 6.3         | 6         | Wind effect shown by irregularity of zero line.<br>After 4.30 p.m., micros. well marked. |
| " 26    | 5.8         | 5         | 6.7         | 7         |  |
| " 27    | 6.1         | 4         | 6.9         | 8         | Decrease after 6 p.m.  |
| " 28    | 5.6         | 2         | 6.3         | 3         | Decreasing.  |
| March 1 | 5.3         | 1         | 5.9         | 2         |  |
| " 2     | 5.5         | 1         | 6.5         | 2         |  |
| " 3     | 4.8         | 6         | 4.6         | 4         | Small but after 5 a.m. (March 4) strong set in.  |
| " 4     | 4.9         | 4         | 5.0         | 3         |  |
| " 5     | 5.4         | 4         | 5.7         | 4         |  |
| " 6     | 5.4         | 2         | 6.2         | 2         | Gradual decrease.  |
| " 7     | 5.8         | 2         | 6.4         | 4         | " increase.  |
| " 8     | 5.7         | 3         | 6.3         | 6         |  |
| " 9     | 5.8         | 2         | 6.3         | 4         | Decrease to small and minute.  |
| " 10    | 5.3         | 1         | 5.5         | 1         |  |
| " 11    | 5.2         | 1         | 5.8         | 1         | Wind effect shown as heretofore.   |
| " 12    | 5.6         | 1         | 6.0         | 1         |  |
| " 13    | 5.3         | 1         | 6.2         | 1         |  |
| " 14    | 5.2         | 1         | 6.4         | 1         |  |
| " 15    | 5.2         | 1         | 6.4         | 1         |  |
| " 16    | 5.4         | 2         | 6.1         | 2         |  |
| " 17    | 5.7         | 2         | 6.4         | 3         |  |
| " 18    | 5.5         | 3         | 6.6         | 5         | Increases to well marked.  |
| " 19    | 5.8         | 3         | 6.5         | 5         | Maximum between 8 & 12 p.m.  |
| " 20    | 5.9         | 4         | 7.0         | 6         | Decreasing.  |
| " 21    | 5.7         | 3         | 6.7         | 4         |  |
| " 22    | 5.8         | 3         | 6.6         | 5         |  |
| " 23    | 5.5         | 3         | 6.8         | 4         | Strongest between 6 & 9 p.m.   |
| " 24    | 5.3         | 2         | 6.4         | 2         |  |
| " 25    | 5.3         | 1         | 5.8         | 1         | Snow storm shows irregularity of zero line.  |
| " 26    | 5.4         | 2         | 6.6         | 3         |  |
| " 27    | 5.5         | 3         | 6.5         | 4         |  |
| " 28    | 5.4         | 3         | 6.5         | 3         |  |
| " 29    | 5.2         | 3         | 6.2         | 3         |  |
| " 30    | 5.3         | 2         | 6.2         | 2         |  |
| " 31    | 5.4         | 1         | 6.4         | 1         |  |

## SESSIONAL PAPER No. 25a

A table was compiled for the official year April 1, 1908, to April 1, 1909, in which were given day by day for every twelve hours, 8 a.m. and 8 p.m. eastern standard time, the position and pressure of the Low, as shown by the charts of the 'Tracks of Centres of Low Areas' published in the United States Monthly Weather Review. In an adjoining column was entered the occurrence and intensity of microseisms on the respective date. The object was to determine if possible the relationship between the existing Low at any particular time and place with the prevailing microseisms at Ottawa. Unfortunately for the purpose in hand the published track of Lows ends generally at the gulf, sometimes near its west coast, and less frequently in Newfoundland, so that the presence of a Low immediately east of the gulf, and which probably is the cause of many of the microseisms, is not noted, with the result that the Low in the west with which the microseisms are bracketed, being the only Low on the chart, is asked, so to speak, to account for the microseisms, when in reality they have nothing to do with it, but are due to the uncharted Low of the vicinity of the gulf or Newfoundland. The comparison between Lows and microseisms as above was consequently very misleading. It resulted in frequently having strong microseisms associated with a Low in the gulf, which is generally the case, but the next day the microseisms would probably persist, while the Low moved eastward beyond the sphere of the chart, yet they would in the table appear opposite to a Low far in the west, with which it could not possibly be related. I have therefore omitted this tabulation.

The following table has been compiled from the charts 'Tracks of centres of Low Areas,' published in the Washington 'Monthly Weather Review.' The object was to see whether the dynamical effect of the daily movement of the Lows across the continent was manifested by microseisms, that is, whether the apparent velocity of translation of the Low produced microseisms, and whether the intensity of the latter was a function of the velocity. The consideration here is independent of the steepness of gradients accompanying a Low. We may have a Low persistent or stationary for some time and this would hence not belong to the above investigation. That same Low may however be surrounded by steep gradients, which, in turn, as shown elsewhere, will be conducive to the appearance of microseisms. The rapidity with which a Low travels across the continent, from west to east, is quite independent of the gradients or isobars that accompany it. In the table, the first column gives the number of the Low for the respective month; the next column headed 'Beginning' gives the day of the month, forenoon—a—at 8 a.m.) or afternoon—p—(8 p.m.) with barometer reading, when the Low began its course; the third column 'Ending' gives the date, forenoon or afternoon, with pressure when the Low ended or rather left the continent. The fourth column, 'Duration,' is the difference between the second and third, expressed in days. The fifth column, 'Distance,' gives the length of the track or path followed by the Low, and was obtained by following on the map with a graduated measuring wheel, adapted for the purpose, the path of the Low from beginning to end across the continent. The odd miles in the distances must not be taken too seriously, they simply show the multiplication of a constant factor by the revolutions and part of a revolution of the wheel measuring the track. The sixth column which gives the division of 'Distance' by 'Duration,' expresses the apparent average daily velocity of the Low across the continent. Finally, the last column shows where the Low was lost to observation or ended as far as the continent is concerned. 'Gulf' refers to the waters and surroundings of the Gulf of St. Lawrence, while 'Atlantic' refers to the ocean along the continent from Maine to Florida. 'Interior' indicates that either the Low disappeared as such in the interior, or was lost to observation in northeastern Canada:—

9-10 EDWARD VII., A. 1910

APRIL, 1908.

| No.  | Beginning. |       | Ending. |       | Duration | Distance. | Apparent<br>average<br>daily<br>velocity. | Disappearance. |
|------|------------|-------|---------|-------|----------|-----------|---|----------------|
|      |            | in.   |         | in.   |          |           |   |                |
| I    | 1a         | 29 70 | 3a      | 29 04 | 2 0      | 1,700     | 850                                       | Gulf.          |
| II   | 3a         | 29 32 | 6a      | 29 64 | 3 0      | 2,480     | 827                                       | "              |
| III  | 6p         | 29 56 | 9a      | 29 18 | 2 5      | 2,340     | 936                                       | "              |
| IV   | 8p         | 29 60 | 12a     | 28 88 | 3 5      | 2,340     | 668                                       | "              |
| V    | 13a        | 29 64 | 16a     | 29 58 | 3 0      | 2,560     | 853                                       | "              |
| VI   | 15p        | 29 68 | 19p     | 29 14 | 4 0      | 3,024     | 756                                       | "              |
| VII  | 17a        | 29 44 | 19p     | 29 14 | 2 5      | 2,832     | 1,133                                     | "              |
| VIII | 20p        | 29 58 | 29a     | 29 72 | 8 5      | 4,576     | 538                                       | "              |
| IX   | 21p        | 29 46 | 29a     | 29 72 | 7 5      | 4,016     | 535                                       | "              |
| X    | 21p        | 29 90 | 23p     | 29 78 | 2 0      | 896       | 448                                       | Atlantic.      |
| XI   | 25p        | 29 42 | 29a     | 29 72 | 3 5      | 2,128     | 608                                       | Gulf.          |
| XII  | 25p        | 29 36 | 29a     | 29 72 | 3 5      | 2,048     | 586                                       | "              |
| XIII | 27p        | 29 70 | 30p     | 29 24 | 3 0      | 2,704     | 901                                       | Atlantic.      |
|      |            |       |         |       |          | Mean      | 742                                       |                |

MAY, 1908.

|      |     |       |     |       |     |       |     |           |
|------|-----|-------|-----|-------|-----|-------|-----|-----------|
| I    | 1a  | 29 08 | 1p  | 29 40 | 0 5 | 160   | 320 | Gulf.     |
| II   | 1a  | 29 64 | 3a  | 29 36 | 2 0 | 1,168 | 584 | "         |
| III  | 2a  | 29 35 | 10a | 29 32 | 8 0 | 3,536 | 442 | "         |
| IV   | 6p  | 29 54 | 9a  | 29 80 | 2 5 | 656   | 262 | Interior. |
| V    | 7a  | 29 60 | 8p  | 29 60 | 1 5 | 976   | 651 | Gulf.     |
| VI   | 8a  | 29 53 | 13a | 29 62 | 5 0 | 3,840 | 768 | "         |
| VII  | 9p  | 29 66 | 13a | 29 62 | 3 5 | 2,784 | 795 | "         |
| VIII | 11a | 29 64 | 18a | 29 92 | 7 0 | 3,376 | 482 | "         |
| IX   | 14p | 29 66 | 20p | 29 76 | 6 0 | 2,860 | 493 | Atlantic. |
| X    | 18a | 29 46 | 19a | 29 58 | 1 0 | 880   | 880 | Interior. |
| XI   | 19a | 29 56 | 24a | 29 98 | 5 0 | 3,264 | 653 | Gulf.     |
| XII  | 23p | 29 64 | 25a | 29 74 | 1 5 | 928   | 619 | Interior. |
| XIII | 24a | 29 92 | 31a | 29 44 | 7 0 | 2,128 | 304 | Gulf.     |
| XIV  | 24p | 29 58 | 27a | 29 64 | 2 5 | 2,144 | 858 | "         |
| XV   | 25a | 29 78 | 31a | 29 44 | 6 0 | 3,104 | 517 | "         |
| XVI  | 25a | 29 70 | 27p | 29 54 | 2 5 | 976   | 390 | Interior. |
|      |     |       |     |       |     | Mean  | 564 |           |

JUNE, 1908.

|      |     |       |     |       |     |         |     |           |
|------|-----|-------|-----|-------|-----|---------|-----|-----------|
| I    | 1a  | 29 76 | 3a  | ..... | 2 0 | 992     | 496 | Gulf.     |
| II   | 2a  | 29 48 | 4p  | 29 52 | 2 5 | 1,450   | 580 | Interior. |
| III  | 4a  | 29 54 | 11p | 29 86 | 7 5 | 3,392   | 452 | Gulf.     |
| IV   | 8p  | 29 70 | 17a | ..... | 8 5 | 2,720   | 320 | "         |
| V    | 17a | 29 52 | 22a | 29 70 | 5 0 | 3,200   | 640 | "         |
| VI   | 22p | 29 56 | 26a | 29 66 | 3 5 | 3,120   | 891 | "         |
| VII  | 24p | 29 68 | 27p | 29 62 | 3 0 | 1,680   | 560 | Interior. |
| VIII | 27p | 29 62 | 30a | 29 82 | 2 5 | 1,840   | 736 | Gulf.     |
|      |     |       |     |       |     | Mean... | 584 |           |



SESSIONAL PAPER No. 25a

JULY, 1908.

| No.  | Beginning. | Ending.   | Duration. | Distance. | Apparent average daily velocity. | Disappearance. |
|------|------------|-----------|-----------|-----------|----------------------------------|----------------|
|      | in.        | in.       | days.     | miles.    | miles.                           |                |
| I    | 2p 29 72   | 9a        | 6 5       | 2,880     | 443                              | Gulf.          |
| II   | 7p 29 78   | 12p       | 5 0       | 2,720     | 544                              | "              |
| III  | 9a 29 88   | 11a       | 2 0       | 496       | 248                              | Atlantic.      |
| IV   | 12a 29 88  | 15p 29 56 | 3 5       | 2,701     | 772                              | Gulf.          |
| V    | 14a 29 80  | 20a       | 6 0       | 3,232     | 539                              | Atlantic.      |
| VI   | 18p 29 86  | 23a       | 4 5       | 2,784     | 619                              | Gulf.          |
| VII  | 19p 29 90  | 22a 30 04 | 2 5       | 1,408     | 563                              | Atlantic.      |
| VIII | 23a 29 68  | 26p 29 88 | 3 5       | 1,216     | 347                              | Interior.      |
| IX   | 29p        | 31p 29 32 | 2 0       | 688       | 344                              | Atlantic.      |
| X    | 27a 29 84  | 30a 30 02 | 3 0       | 1,456     | 485                              |                |
|      |            |           |           | Mean.     | 491                              |                |

AUGUST, 1908.

|     |           |           |     |       |     |       |
|-----|-----------|-----------|-----|-------|-----|-------|
| I   | 1a 29 66  | 3a        | 2 0 | 960   | 480 | Gulf. |
| II  | 1p 29 44  | 10a 29 80 | 8 5 | 2,928 | 314 | "     |
| III | 10p 29 56 | 14p 29 80 | 4 0 | 2,240 | 560 | "     |
| IV  | 13a 29 80 | 19a 29 60 | 1 0 | 2,528 | 632 | "     |
| V   | 20a 29 70 | 24a 29 98 | 4 0 | 2,440 | 610 | "     |
|     |           |           |     | Mean. | 525 |       |

SEPTEMBER, 1908.

|      |           |           |     |       |       |           |
|------|-----------|-----------|-----|-------|-------|-----------|
| I    | 1a 29 90  | 3a        | 2 0 | 1,424 | 712   | Gulf.     |
| II   | 4p        | 7a        | 2 5 | 1,960 | 784   | "         |
| III  | 6a 29 84  | 7a        | 1 0 | 1,024 | 1,024 | "         |
| IV   | 8a 29 86  | 9a 29 02  | 1 0 | 736   | 736   | Interior. |
| V    | 11a       | 18a       | 7 0 | 2,320 | 331   | Gulf.     |
| VI   | 14p 29 66 | 19a 29 78 | 4 5 | 2,080 | 462   | Interior. |
| VII  | 23a 29 82 | 23a       | 6 0 | 3,040 | 507   | Gulf.     |
| VIII | 28p       | 30p 29 68 | 2 0 | 1,680 | 840   | Interior. |
|      |           |           |     | Mean. | 674   |           |

OCTOBER, 1908.

|      |           |           |     |       |       |           |
|------|-----------|-----------|-----|-------|-------|-----------|
| I    | 1p 29 90  | 2p        | 1 0 | 704   | 704   | Gulf.     |
| II   | 2a 29 28  | 3p 29 56  | 1 5 | 560   | 373   | Interior. |
| III  | 8a        | 11p 29 68 | 3 5 | 2,240 | 640   | Gulf.     |
| IV   | 8p 29 72  | 11p 29 68 | 3 0 | 2,544 | 848   | "         |
| V    | 14a 29 36 | 15a 29 30 | 1 0 | 1,200 | 1,200 | Interior. |
| VI   | 14p 29 56 | 17p       | 3 0 | 1,888 | 629   | "         |
| VII  | 15p 29 46 | 17p 29 90 | 2 0 | 960   | 480   | "         |
| VIII | 17p 29 68 | 21p       | 4 0 | 2,099 | 525   | "         |
| IX   | 20p 29 58 | 27a 29 90 | 6 5 | 2,144 | 329   | "         |
| X    | 26a       | 27p       | 1 5 | 1,056 | 704   | Gulf.     |
| XI   | 27p       | 30p 29 06 | 3 0 | 2,120 | 707   | "         |
|      |           |           |     | Mean. | 649   |           |

9-10 EDWARD VII., A. 1910

NOVEMBER, 1908.

| No.       | Beginning |       | Ending |       | Duration | Distance | Apparent<br>average<br>daily<br>velocity. | Disappearance. |
|-----------|-----------|-------|--------|-------|----------|----------|---|----------------|
|           | in.       |       | in.    |       | days.    | miles.   | miles.                                    |                |
| I         | 1p        | 29 66 | 4p     | 29 20 | 3 0      | 2,944    | 981                                       | Gulf.          |
| II        | 5a        | 29 72 | 6p     | 29 16 | 1 5      | 1,480    | 987                                       | "              |
| III       | 8p        | 29 66 | 12a    | 29 46 | 3 5      | 2,400    | 686                                       | "              |
| IV        | 14a       | 29 96 | 15a    | 29 60 | 1 0      | 1,480    | 1,480                                     | "              |
| V         | 16p       | 29 54 | 18p    | 29 60 | 2 0      | 2,304    | 1,152                                     | "              |
| VI        | 17p       | 29 50 | 20a    | 29 88 | 2 5      | 2,336    | 934                                       | "              |
| VII       | 21a       | 29 88 | 25a    | 29 52 | 4 0      | 1,424    | 356                                       | Interior.      |
| VIII      | 23a       | 29 64 | 25a    | 29 52 | 2 0      | 1,000    | 500                                       | "              |
| IX        | 23p       | 29 70 | 26a    | 29 06 | 2 5      | 2,048    | 819                                       | "              |
| X         | 27a       | 29 84 | 30p    | 29 04 | 3 5      | 1,936    | 553                                       | "              |
| XI        | 28a       | 29 90 | 30p    | 29 04 | 2 5      | 1,984    | 793                                       | "              |
| XII       | 29a       | 29 52 | 30p    | 29 04 | 1 5      | 1,408    | 938                                       | "              |
| Mean..... |           |       |        |       |          |          | 848                                       |                |

DECEMBER, 1908.

|           |     |       |     |       |     |       |       |           |
|-----------|-----|-------|-----|-------|-----|-------|-------|-----------|
| I         | 2p  | 30 06 | 4p  | 29 62 | 2 0 | 2,176 | 1,088 | Gulf.     |
| IIa       | 5a  | 29 82 | 7a  | 29 86 | 2 0 | 2,128 | 1,064 | "         |
| IIb       | 5a  | 29 82 | 7p  | 29 28 | 2 5 | 2,656 | 1,062 | "         |
| III       | 9a  | 29 68 | 12p | 29 04 | 3 5 | 2,640 | 754   | "         |
| IV        | 11a | 29 50 | 14a | 29 48 | 3 0 | 2,720 | 907   | "         |
| V         | 12p | 29 06 | 16a | 29 72 | 3 5 | 2,944 | 841   | "         |
| VI        | 14a | 29 72 | 17p | ..... | 3 5 | 640   | 183   | Interior. |
| VII       | 16a | ..... | 18p | 29 42 | 2 5 | 1,504 | 602   | Atlantic. |
| VIII      | 18a | 29 86 | 19a | 29 94 | 1 0 | 1,280 | 1,280 | "         |
| IX        | 21a | 30 00 | 23a | ..... | 2 0 | 1,520 | 760   | "         |
| X         | 23a | 29 78 | 26a | 29 28 | 3 0 | 2,240 | 747   | Gulf.     |
| XI        | 25a | 29 62 | 28a | 29 66 | 3 0 | 2,880 | 960   | "         |
| XII       | 28a | 29 40 | 31a | 29 58 | 3 0 | 2,560 | 853   | "         |
| Mean..... |     |       |     |       |     |       | 854   |           |

JANUARY, 1909.

|           |     |       |     |       |     |       |       |           |
|-----------|-----|-------|-----|-------|-----|-------|-------|-----------|
| I         | 2a  | 29 70 | 6a  | 29 36 | 4 0 | 2,000 | 500   | Gulf.     |
| II        | 3a  | 29 60 | 5p  | 29 84 | 2 5 | 1,824 | 730   | Interior. |
| III       | 3p  | 29 58 | 6a  | 29 36 | 2 5 | 3,008 | 1,203 | Gulf.     |
| IV        | 7a  | 29 66 | 10p | 29 86 | 3 5 | 1,328 | 379   | Interior. |
| V         | 10a | 29 92 | 11a | 29 80 | 1 0 | 1,088 | 1,088 | Gulf.     |
| VI        | 12p | 29 60 | 15a | 29 66 | 2 5 | 2,044 | 1,177 | "         |
| VII       | 15a | 30 00 | 18a | 29 70 | 3 0 | 2,608 | 869   | "         |
| VIII      | 19a | 29 18 | 21a | 29 70 | 2 0 | 1,640 | 820   | Interior. |
| IX        | 21p | 28 90 | 26a | 29 56 | 4 5 | 3,344 | 743   | Gulf.     |
| X         | 25p | 29 74 | 27p | 29 30 | 2 0 | 2,016 | 1,008 | "         |
| XI        | 27p | 29 72 | 31a | 29 12 | 3 5 | 2,240 | 640   | "         |
| Mean..... |     |       |     |       |     |       | 832   |           |

SESSIONAL PAPER No. 25a

FEBRUARY, 1909.

| No.  | Beginning. |       | Ending. |       | Duration. | Distance | Apparent average daily velocity. | Disappearance. |  |
|------|------------|-------|---------|-------|-----------|----------|----------------------------------|----------------|--|
|      |            | in.   |         | in.   | days.     | miles.   | miles.                           |                |  |
| I    | 3a         | 29 64 | 6p      | 28 98 | 3 5       | 2,528    | 722                              | Gulf.          |  |
| II   | 4a         | 29 48 | 6p      | 28 98 | 2 5       | 2,208    | 883                              | "              |  |
| III  | 5a         | 29 36 | 7p      | 29 70 | 2 5       | 2,600    | 1,040                            | Atlantic.      |  |
| IV   | 5p         | 29 60 | 7p      | 29 70 | 2 0       | 1,800    | 900                              | "              |  |
| V    | 7a         | 29 42 | 10p     | 29 30 | 3 5       | 2,760    | 739                              | Interior.      |  |
| VI   | 11p        | 29 68 | 17a     | 29 40 | 5 5       | 3,059    | 556                              | Gulf.          |  |
| VII  | 13a        | 29 58 | 17a     | 29 40 | 4 0       | 3,136    | 784                              | "              |  |
| VIII | 16p        | 29 44 | 20p     | 28 94 | 4 0       | 3,536    | 884                              | "              |  |
| IX   | 20a        | 29 66 | 25p     | 29 02 | 5 5       | 4,200    | 764                              | "              |  |
| X    | 21a        | 29 66 | 27p     | 29 58 | 3 5       | 3,168    | 905                              | "              |  |
|      |            |       |         |       |           |          | Mean . . . .                     | 825            |  |

MARCH, 1909.

|      |          |       |     |       |     |       |              |           |  |
|------|----------|-------|-----|-------|-----|-------|--------------|-----------|--|
| I    | 28p Feb. |       | 2p  | 29 78 | 2 0 | 1,664 | 832          | Atlantic. |  |
| II   | 28p Feb. |       | 2p  | 29 74 | 2 0 | 1,664 | 832          | "         |  |
| III  | 1a       | 29 38 | 5a  | 29 00 | 4 0 | 3,744 | 936          | Gulf.     |  |
| IV   | 4p       | 29 60 | 7p  | 29 62 | 3 0 | 2,880 | 960          | "         |  |
| V    | 5a       | 29 65 | 7p  | 29 62 | 2 5 | 2,016 | 806          | "         |  |
| VI   | 5p       | 29 78 | 10p | 29 42 | 5 0 | 3,840 | 768          | "         |  |
| VII  | 12a      | 29 98 | 14p | 29 62 | 2 5 | 2,560 | 1,024        | "         |  |
| VIII | 15a      | 30 22 | 18a | 29 48 | 3 0 | 1,920 | 640          | Atlantic. |  |
| IX   | 16a      | 29 88 | 20a | 29 58 | 4 0 | 3,040 | 760          | "         |  |
| X    | 18a      | 29 64 | 21p | 29 72 | 3 5 | 2,240 | 640          | "         |  |
| XI   | 19p      | 29 72 | 22a | 29 92 | 2 5 | 1,216 | 486          | Interior. |  |
| XII  | 22p      | 29 76 | 26a | 29 10 | 3 5 | 2,720 | 777          | "         |  |
| XIII | 22p      | 29 68 | 26a | 29 10 | 3 5 | 2,624 | 750          | "         |  |
| XIV  | 24p      | 29 54 | 29a | 29 08 | 4 5 | 2,432 | 540          | Gulf.     |  |
| XV   | 26a      | 29 70 | 29a | 29 08 | 3 0 | 2,720 | 907          | "         |  |
|      |          |       |     |       |     |       | Mean . . . . | 777       |  |

The result of the comparison of the preceding table with the microseisms prevailing at corresponding dates may be briefly stated. There is a general relationship between the movements of Lows and microseisms, that is, that during the winter months when the average movement is greater than during the summer months, the microseisms are more frequent and stronger during the former period than during the latter, but when we look for an increase of microseisms with an increase of movement of Lows, we find that the two phenomena are by no means always synchronous. We are therefore obliged to deny the relationship of cause and effect between these two phenomena.

As is shown elsewhere the true relationship lies between the isobars and gradients, their geographic position, the ocean and the microseisms.

MAREOGRAMS.

Very recently through the kindness of Dr. W. Bell Dawson, Superintendent of the Tidal Survey, I had an opportunity of examining the mareograms of St. Paul island for the year 1904, and those for May-December, 1908, the latter, the latest received.

St. Paul is a small rocky island in Cabot strait, the main entrance to the Gulf of St. Lawrence, between Cape North in Cape Breton Island and Cape Ray in Newfoundland, but near to the former. It is almost surrounded by the 100-fathom (183 meters)

line and lies just outside and westward of the St. Lawrence Deep running from the Atlantic ocean (1,000-fathom-line) to the mouth of the St. Lawrence, opposite Matane, a distance of about 630 miles (1,014km.). Cabot strait, 65 miles wide, 250 fathoms deep, is the main entrance to the gulf; the other, the Strait of Belle Isle, is only 11 miles wide at its narrowest part and has less than 50 fathoms of water. The gulf itself is about 450 miles long in a N.W.-S.E. direction, and 350 miles in a N.E.-S.W. direction. The greater part of the gulf is less than 100 fathoms deep.

The object of the scrutiny of these mareograms was to examine the secondary oscillations, which are superposed on the regular tidal movements, and to see if any relationship exists between the occurrence and intensity of these secondary oscillations and the microseisms registered at Ottawa. For the study of the oscillations in the gulf, the mareograms of St. Paul seemed the most suitable.

Secondary oscillations have received considerable attention by various investigators, but so far without conclusive proof of their cause. Last year the Earthquake Investigation Committee of Japan issued a report on 'The secondary oscillations of Ocean Tides.' In the investigation 'Professor Omori was led to the conclusion that the bays or inlets oscillate like fluid pendulums with periods peculiar to their own.'

Records were obtained from many bays about the Japanese coast by specially designed portable tide-gauges and the results tabulated. The period of oscillation was computed by the formula  $t = \frac{1}{\sqrt{g}} \frac{l}{h}$  where  $l$  = length of bay,  $h$  = mean depth, and  $g$  = acceleration. The denominator represents the velocity of the long waves.

The observed and calculated periods, although ranging for different bays very widely, from 9<sup>m</sup> to 363<sup>m</sup>, agree pretty well throughout. This part of the investigation seems to show conclusively that each bay has its own inherent period or note like a tuning fork, and will oscillate with its own period 'if it be excited by waves in the external sea having the synchronizing component.' From this it would follow that we can get little or no information about the period of the microseisms as dependent upon the periods of the bays, for microseisms with the same period obtain or prevail over very large areas, tens or hundreds of thousands of square kilometres in extent. However, 'as to the cause of the long waves which manifest themselves as secondary undulations,' the above report says, 'we may mention the wind, the cyclone, the earthquake, &c.' In short, the report does not show that the change of atmospheric pressure is the direct cause of these secondary oscillations and is indicated by them.

Coming now to the mareograms of St. Paul island, it is found that:

- (1) Secondary oscillations are always present throughout the year.
- (2) The range or double amplitude varies, being greater in winter than in summer. The range running from 1cm. to 30cm.
- (3) The period is practically constant throughout the year and years (1904 and 1905), being about 4.6 min., deviating from this by only one or two-tenths of a minute, and this deviation may be partly due to difficulty in measuring the period accurately.
- (4) Small oscillations in amplitude show less interference phenomena than do the larger ones.
- (5) There is a fair correspondence between the occurrence of Lows with steep gradients in or about the gulf and large amplitudes for the secondary oscillations; but this coincidence is not nearly so well marked as in the relation between such Lows and microseisms.
- (6) The cause of these secondary oscillations is in the main due to changes of barometric pressure.
- (7) As the period of the oscillations is practically constant, and the disturbing cause variable, the period must be a function of the topography and hydrography, that is, the depth of water and extent of basin.

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Although the 100-fathom line almost surrounds the island, yet one would not be justified in using its dimensions for computing the period for the oscillations there. Such would give about 31 minutes.

The following table gives the period and range (double amplitude) of mareograms at St. Paul island. The dates are taken more or less at random, but always of such records where the pencil tracings were still clear, as in some cases they were somewhat obliterated by inking in a smooth tidal curve:—

SECONDARY OSCILLATIONS ON MAREOGRAMS RECORDED AT ST. PAUL ISLAND, CABOT STRAIT.  
The tide-sheets cover alternately 3 and 4 days. Time scale, 1<sup>b</sup> =  $\frac{2}{3}$  inch. Vertical scale, 1 in. = 1 ft.

| Date.        | Period. | Range<br>Units of<br>1/20 ft. | Date.        | Period. | Range<br>Units of<br>1/20 ft. | Date.         | Period. | Range<br>Units of<br>1/20 ft. |
|--------------|---------|-------------------------------|--------------|---------|-------------------------------|---------------|---------|-------------------------------|
| 1901.        | min.    |                               | 1908.        | min.    |                               | 1908.         | min.    |                               |
| Jan. 3.....  | 4.0     | 15                            | May 18.....  | 4.5     | 4                             | Sept. 11..... | 4.6     | 12                            |
| " 9.....     | 4.0     | 20                            | " 29.....    | 4.8     | 11                            | " 18.....     | 4.8     | 5                             |
| " 14.....    | 3.2     | 17                            | June 2.....  | 5.0     | 2                             | " 21.....     | 4.5     | 3                             |
| " 27.....    | 4.0     | 5                             | " 7.....     | 4.6     | 2                             | " 25.....     | 4.8     | 3                             |
| Feb. 7.....  | 4.5     | 4                             | " 17.....    | 4.6     | 7                             | " 29.....     | 4.8     | 2                             |
| Mar. 4.....  | 4.6     | 6                             | " 21.....    | 4.6     | 4                             | Oct. 2.....   | 4.6     | 6                             |
| " 23.....    | 4.3     | 9                             | " 23.....    | 4.5     | 4                             | " 6.....      | 4.8     | 2                             |
| " 24.....    | 4.3     | 3                             | " 26.....    | 4.6     | 3                             | " 9.....      | 4.5     | 3                             |
| Apr. 16..... | 4.5     | 7                             | " 30.....    | 4.5     | 2                             | " 14.....     | 4.3     | 3                             |
| " 18.....    | 4.4     | 9                             | July 3.....  | 4.6     | 1                             | " 20.....     | 4.5     | 4                             |
| May 2.....   | 4.8     | 3                             | " 7.....     | 4.5     | 2                             | " 24.....     | 4.8     | 3                             |
| " 8.....     | 4.6     | 2                             | " 12.....    | 4.6     | 3                             | " 26.....     | 4.6     | 2                             |
| " 18.....    | 4.6     | 2                             | " 14.....    | 4.5     | 2                             | " 31.....     | 4.6     | 7                             |
| June 30..... | 4.6     | 2                             | " 17.....    | 4.6     | 2                             | Nov. 9.....   | 4.6     | 3                             |
| July 3.....  | 4.3     | 2                             | " 20.....    | 4.8     | 2                             | " 12.....     | 4.8     | 8                             |
| " 7.....     | 4.3     | 3                             | " 24.....    | 5.0     | 2                             | " 16.....     | 4.5     | 7                             |
| Aug. 8.....  | 4.6     | 2                             | " 31.....    | 4.6     | 2                             | " 19.....     | 4.6     | 8                             |
| " 26.....    | 4.8     | 4                             | Aug. 3.....  | 4.4     | 2                             | " 24.....     | 4.6     | 5                             |
| Sept. 1..... | 4.3     | 5                             | " 7.....     | 4.6     | 2                             | " 27.....     | 4.4     | 5                             |
| " 12.....    | 4.6     | 3                             | " 14.....    | 4.3     | 2                             | Dec. 1.....   | 4.6     | 5                             |
| Oct. 1.....  | 4.3     | 5                             | " 22.....    | 4.6     | 2                             | " 3.....      | 4.6     | 8                             |
| " 8.....     | 4.3     | 3                             | " 26.....    | 4.3     | 2                             |               |         |                               |
| Nov. 13..... | 4.5     | 4                             | " 29.....    | 4.6     | 8                             |               |         |                               |
| " 15.....    | 4.3     | 8                             | Sept. 1..... | 4.3     | 2                             |               |         |                               |
| " 25.....    | 4.5     | 5                             | " 4.....     | 4.5     | 2                             |               |         |                               |

Another examination of mareograms was made, and that for Trepassey, near Cape Race, Newfoundland, the extreme point jutting into the broad Atlantic. It showed very marked secondary oscillations, exceeding both in period and in amplitude those of St. Paul island greatly. While the mean period of the latter is 4.6 minutes, that of the former is 67.6 minutes, about 15 times as large; and the range reaches over three and a half feet, while for the other it seldom reaches half a foot. The distance apart of these two stations is about 300 miles, but the tidal movement coming from the southeast reaches them about simultaneously. The general movement of the atmosphere or areas of Lows and Highs is easterly, and the barometric conditions prevailing at the two stations are, allowing for time interval in passing from one to the other, fairly similar, yet we find these great differences in the secondary oscillations. We must hence again conclude that their period as well as amplitude must be dependent upon surroundings of the station, *i.e.*, topography-hydrography, or depth of water and extent of basin. Land-locked basins, as shown by the mareograms of Halifax and other places, show little of secondary oscillations, and those shown are generally irregular, which is an experience quite different from that cited for the Japanese coast.

Taking the above two stations which are exposed to the Atlantic, and noting their very different periods, there does not appear to be any very obvious connection between them and the microseisms.

Some investigators believe that the breaking of the waves on the shore sets up tremors in the earth's crust, which may manifest themselves to great distances. To this I am not at present prepared to give assent. My investigations have established more or less synchronous phenomena, but how they are related—as cause and effect—is not yet fully determined.

The following table from the mareograms for Trepassey is similar to the preceding one for St. Paul island. It may be noted that at Trepassey there was at times a tertiary oscillation of a period of 2 minutes or less superimposed on the secondary oscillations. The selection of dates is more or less at random. The mean for each of the four months available is given, and it will be seen that the periods are about the same:—

SECONDARY OSCILLATIONS on mareograms recorded at Trepassey, Newfoundland. Time scale 1<sup>h</sup> = ½ inch. Vertical scale 1 in. = 6 ft.

| Date.   | Period. | Range. | Date.      | Period. | Range. |
|---------|---------|--------|------------|---------|--------|
| 1902.   | min.    | ft.    | 1902.      | min.    | ft.    |
| Aug. 22 | 64      | 3'     | Oct. 9     | 68      | 3'0    |
| " 25    | 77      | 2'5    | " 13       | 71      | 3'5    |
| " 26    | 74      | 3'     | " 15       | 65      | 3'0    |
| " 27    | 63      | 1'5    | " 23       | 66      | 3'0    |
| Mean    | 69'5    |        | " 31       | 64      | 3'0    |
| Sept. 1 | 65      | 2'5    | Mean       | 66'8    |        |
| " 2     | 65      | 3'0    | Nov. 3     | 67      | 1'5    |
| " 5     | 76      | 2'0    | " 5        | 64      | 2'0    |
| " 6     | 68      | 2'5    | " 6        | 71      | 3'0    |
| " 24    | 68      | 3'5    | " 11       | 63      | 3'0    |
| " 26    | 67      | 2'0    | " 17       | 64      | 2'0    |
| Mean    | 68'2    |        | Mean       | 65'8    |        |
|         |         |        | Grand mean | 67'6    |        |

After these various examinations we arrive at the following conclusions:—

- (1) Microseisms are essentially due to meteorological phenomena, that is, to barometric pressure and the accompanying gradients.
- (2) The amplitude of microseisms is largely a function of the steepness of the barometric gradient.
- (3) Areas of low barometer with steep gradients, but west of Ottawa, have little effect in producing microseisms.
- (4) Strong microseisms are almost invariably accompanied by steep gradients in the gulf, with the St. Lawrence valley, containing the Great Champlain fault, on a line of steep gradients.
- (5) A well-marked Low sweeping up the Atlantic coast from Florida to Newfoundland is almost invariably accompanied by marked microseisms.
- (6) Microseisms are but slightly, if at all, influenced by the movement of Lows across the continent.
- (7) Microseisms are not produced by local winds, frictional excitation of the earth's surface.

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- (8) Microseisms represent movements in vast blocks of the earth's crust, covering tens of thousands of square miles; and the period is possibly dependent on or modified by marked geological configuration and depth.
- (9) Microseisms once produced may continue for a day or two when the immediate cause has passed.

## ACCELERATION.

The acceleration produced here by earthquakes for the period of the report, April 1, 1908, to March 31, 1909, has in all cases been small. The destructiveness of an earthquake is dependent upon the acceleration and this is measured by the absolute displacement of the earth particles and the period of the oscillation. The absolute displacement is obtained from the seismogram on which the magnified movement is read in terms of millimetres. This latter is converted into absolute measure by application of the magnification factor.

The general expression for the oscillation of a pendulum is  $T_0 = 2\pi \sqrt{\frac{L}{g}}$  where

$T_0$  = period, *i.e.*, the oscillation to and fro,  $L$  = length of the pendulum (in metres),  $g$  = acceleration for the particular latitude, being for latitude  $45^\circ$ , 9.806 metres, and  $\pi = 3.1416$ , or the ratio of the semi-circumference of a circle to the radius.

If in a horizontal pendulum we have observed its period,  $T_0$ , without damping of the pendulum, the deduced  $L$  is called the 'equivalent length,' being that of a simple pendulum having the same period.

As the square root of  $g$  (9.81) is approximately the value of  $\pi$ , we obtain the approximate relation

$$T_0 = 2\sqrt{L}, \text{ or } L = \left(\frac{T_0}{2}\right)^2$$

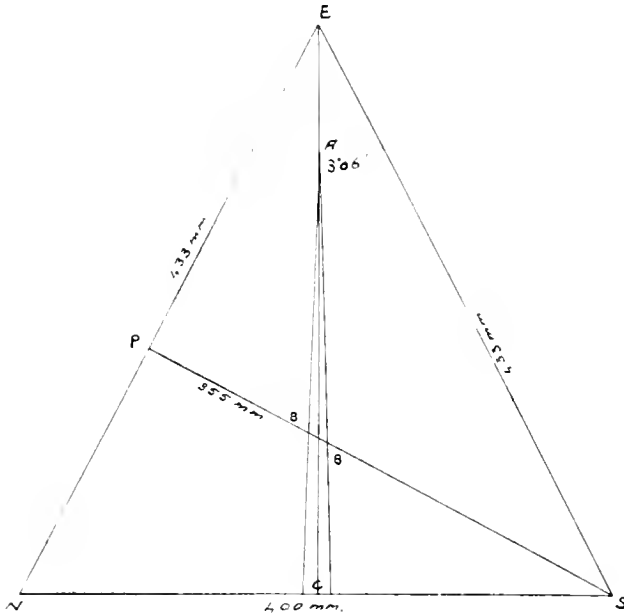
The magnification of the actual movement of the pendulum is effected in seismographs either by a system of levers or by means of a mirror attached to the pendulum. The former method is adopted where there is mechanical registration by a stylus on smoked paper, or by a light glass tube drawn to a fine point and filled with ink, and the latter method for photographic registration as is the case for our seismograph. The magnification in the latter case is simply double the ratio of the actual length of the pendulum to the distance of the recording cylinder from the axis of oscillation of the pendulum.

We may regard the magnification to be produced by the extension of our simple pendulum of the above length  $L$  to the length  $J$ , which is called the 'equivalent indicator length,' so that the magnification or  $V = \frac{J}{L}$ . The determination of  $V$  for our

Bosch photographic seismograph was made directly from measurements of the parts composing the horizontal pendulum and therefrom computing the length of the simple pendulum that would have the same period as the horizontal pendulum when the latter swung in a vertical plane. This deduced length divided into twice the distance of the recording cylinder gave  $V = 120$ . Some of the heavy astatic Wiechert pendulums, weight 17,000 kgm. (ours is 200 gms.!) have a lever magnification of upwards of 2,000.

As stated in a previous report, the period of the horizontal pendulum is simply a matter of adjustment of the axis about which it swings with reference to the vertical. We may here give an investigation that I made during the past year for tilting

and period of the east-west pendulum, *i.e.*, of the one giving the north-south component.



In the accompanying diagram *E, N, S* represent the three footscrews of the pendulum stand. *E, N* the axis of rotation with reference to tilting done by footscrew *S*. *A* is the vertical projection of the lower point of pendulum support.

*B* is the vertical projection of the upper point of pendulum support, when arc on footscrew *S* reads  $0^\circ$ .

*B'* similarly when arc on footscrew *S* reads  $90^\circ$ .

(*Note.*—In linear measure the triangle *A, B, B'* is much exaggerated in scale; the angles are however to scale.)

The top of the base-plate is 92 mm. above the pier.

Lower support above top of base-plate, 27.5 mm.

Centre of bob above top of base-plate, 25 mm.

Distance between supports of pendulum, 166.7 mm.

Thread of footscrew very nearly  $\frac{1}{40}$  inch, say  $\frac{1}{2}$  mm.

The tilting was done with the south footscrew by turning it through  $90^\circ$ . A special brass arm, graduated through  $90^\circ$  into half-degree spaces and attached concentrically with the footscrew, together with a fixed pointer, opposite the graduations, securely placed on the pier, were used in the experiments.

We have then in linear measure for  $90^\circ$  turn of the footscrew  $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$  mm., and the angular measure will be  $\theta$ , where  $\sin \theta = \frac{1}{8} \div 355 = .0004401$ , hence  $\theta = 90'' \cdot 8$ .

Four measurements of raising and lowering by a quarter turn, or  $90^\circ$ , by south footscrew gave displacements of image at cylinder by pendulum mirror over point of lower support, respectively:  $1' 4\frac{1}{2}''$ ,  $1' 5''$ ,  $1' 6''$ ,  $1' 5\frac{3}{4}''$ , mean  $1' 5\frac{1}{4}'' = 438$ mm.



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Distance of image from mirror, 4,060 mm. Hence angle swept over by image =  $a$ , and  $\tan \frac{a}{2} = \frac{219}{4060} = .054$ ,  $a = 6' 12$  and the angle swept over by the pendulum =  $\frac{a}{2} = 3' 06'$ .

The upper point of support is 166.7 mm. vertically above the lower one. By the quarter turn of the footscrew we have an angular motion of  $90''.8$ , hence the *relative* displacement of the upper point of support to the lower one will be  $x$ , where  $\frac{x}{166.7} = \tan 90''.8$ , therefore  $x = .073382 \text{ mm.} = B B'$ .

This displacement is in a plane, perpendicular to the axis of rotation  $EN$ . Reducing to the perpendicular of  $AC$  this becomes .06509 mm.

Remembering that  $AC$  is the normal position of the pendulum, we have in the triangle formed by the two positions of the upper point of support and the lower one due to readings of  $0^\circ$  and  $90^\circ$  on the footscrew, the angle at the apex  $3^\circ 06'$  from above, and the reduced opposite side .06509 mm., hence the horizontal distance between the two points is  $d$ , where  $.06509 \div d = \sin 3^\circ 06'$ , therefore  $d = 1.2036 \text{ mm.}$

It follows that the angle between the points of support and the vertical is  $\gamma$ , where  $\tan \gamma = \frac{1.2036}{166.7} = 24' 49''.25$ .

By previous determination we have the distance from the centre of oscillation to the axis of rotation of the pendulum 66.774 mm., hence the length of the equivalent pendulum is  $L = \frac{66.774}{\sin 24' 49''.25} = 9248.4 \text{ mm.}$ , therefore the period =  $2\pi \sqrt{\frac{L}{g}} = 6^s.10$  ( $g$  for  $45^\circ = 9806 \text{ mm.}$ )

By direct observation on the day of the above investigation, the period was found to be  $6^s.15$ , being in satisfactory agreement with the above value.

The method of deflection of image is more accurate for the determination of the period than direct observation.

For the above adjustment of pendulum  $1''$  tilting was equivalent to a displacement of the image of 5.42 mm., or 1 mm. deflection of image =  $'' .184$  tilting north-south. Similar experiments were carried out with the other pendulum, the  $N-S$  one, giving the east-west component. The instrument is identical with the other; it is mounted on the same pier, but its adjustment was different at the time.

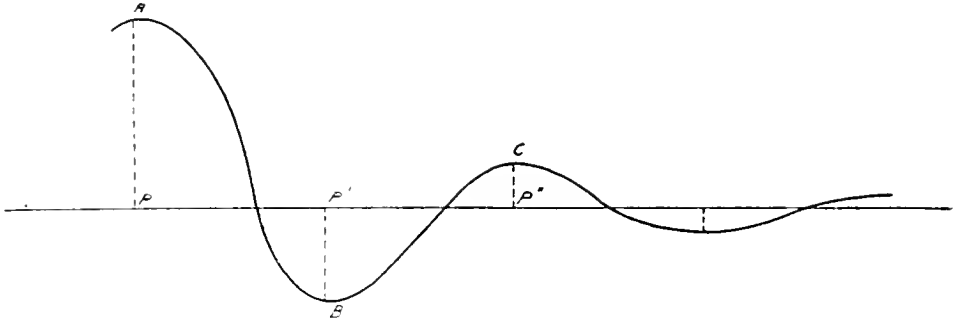
For it was found a period of  $12^s.56$ , and 1 mm. deflection of the image represented a tilt of  $'' .0444$ . As one can read to a tenth of a millimetre, we see that for the adjustment of the latter pendulum one can detect tilting of  $'' .0044$ , which is equivalent to about 1 inch in 710 miles.

Without damping, a horizontal pendulum set in motion would continue to oscillate for an indefinite time and with equal amplitudes, leaving out of consideration for the moment the effect of friction at the points of support. This latter would effect a reduction in amplitude in arithmetical progression.

As the principal function of the seismograph is to record the true movements of the earth, both in time and magnitude, it is essential that its own personality regarding swing should be obliterated as much as possible, that is, that it should subside unless acted on by the earth movements. This is effected to a greater or less degree by air, oil or electro-magnetic damping. In our Bosch instrument an air chamber forms a cushion within which a vane of the pendulum moves.

The effect of damping is to reduce the amplitudes in geometrical progression instead of arithmetical, as in the case with friction. Friction will ultimately stop a pendulum, but with damping the amplitude curve is asymptotic, and hence the time infinite.

The 'damping ratio' is understood to be the ratio of the amplitude of a swing from the zero line to the next amplitude on the opposite side, as shown by the accompanying diagram.



Damping ratio =  $\frac{A P}{B P'} = \frac{B P''}{C P''} = 1 : f$ ; hence in time  $\frac{T}{2}$ , where  $T$  = period of damped pendulum we have the ratio  $1 : f$ .

In time  $2 \left(\frac{T}{2}\right)$  the ratio  $1 : f^2$ , and in general for  $n \left(\frac{T}{2}\right)$  the ratio is  $1 : f^n$ .

If we call  $x \left(\frac{T}{2}\right)$  the time in which the amplitude is reduced  $\left(\frac{1}{e}\right)^{\text{th}}$  of its value, where  $e$  is the base of the natural or Napierian logarithms, then for time  $x \left(\frac{T}{2}\right)$  we have  $1 : f^x = 1 : e^{-1}$ .

Let  $\tau = x \left(\frac{T}{2}\right)$ ,  $\therefore x = \frac{2\tau}{T}$ , hence  $1 : f = 1 : e^{-\frac{1}{f}} = 1 : e^{-\frac{T}{2\tau}} = e^{\frac{T}{2\tau}} : 1$ .

The quantity  $e^{\frac{T}{2\tau}}$  is generally designated by  $\epsilon$ .

The effect of damping changes the period of the pendulum when swinging freely, and the relation between the two is expressed by

$$T_0 = \frac{T}{\sqrt{1 + \left(\frac{T}{2\pi\tau}\right)^2}}$$

in which  $T$  is the damped period.

The magnification of the earth movement of earthquakes, as recorded on the seismogram by the damped pendulum, is dependent upon the period of such earth movement, hence the magnification is not a constant quantity for interpreting the amplitudes. Professor Wiechert in his 'Theorie der automatischen Seismographen,' gives the following formula for the derivation of the magnification:—

$$\cdot \mathcal{C} = \frac{V}{\sqrt{\left\{1 - \left(\frac{T_v}{T_0}\right)^2\right\}^2 + 4\left(\frac{T_0}{2\pi\tau}\right)^2 \left(\frac{T_v}{T_0}\right)^2}}$$

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From relations we have found before, this may be put in the form

$$\rho = \sqrt{\left\{ 1 - \left( \frac{T_r}{T_0} \right)^2 \right\}^2 + \frac{V}{\pi^2 + (\text{nat. log } \epsilon)^2} \left( \frac{T_r}{T_0} \right)^2}$$

or using the common logarithms we have

$$\rho = \sqrt{\left\{ 1 - \left( \frac{T_r}{T_0} \right)^2 \right\}^2 + \frac{V}{1 + (.733 \log \epsilon)^2} \left( \frac{T_r}{T_0} \right)^2}$$

in which  $T_e$  is the period of the earth particles;  $T_0$  is the period of undamped pendulum; and the other symbols as previously designated.

It will be observed that this gives wide variations in the magnification, dependent upon the relative values of  $T_e$  and  $T_0$ , and also upon the damping co-efficient. The value best suited for  $\epsilon$  lies between 3 and 8.

We now come to the evaluation of the acceleration from the amplitude and period of the recorded earth movements. We have the general expression for normal acceleration =  $\frac{r^2}{r}$ , in which  $r = \frac{2\pi r}{T_e}$ , and  $r$  is the amplitude, or half range of the oscillation measured on the seismogram, and expressed in microns or  $\frac{1}{1000}$  millimetres. The value of  $r$  is obtained by dividing the linear measure on the seismogram by the appropriate  $\rho$  for the particular period of  $T_e$ . The result is expressed in milligals, where 1 gal is the acceleration of 1 cm. = 10 mm. = 10,000  $\mu$  per second, per second, and a milligal is  $\frac{1}{1000}$  of a gal. Gravity would therefore be represented by 980.6 gal (for  $\phi = 45^\circ$ ), so that approximately a milligal is the one millionth of gravity.

The acceleration  $\Delta g$  in milligals is given by the approximate formula  $\Delta g = \frac{4A}{T_e^2}$ , where  $A$  is the amplitude ( $\frac{1}{2}$  range) expressed in microns, and  $T_e$  the period in seconds.

As Ottawa is several thousand miles from the nearest seismic area—the West Indies, Mexico or California—the acceleration produced here is always very small, and of course the destructive earthquakes which have occurred there in recent years were not felt here.

During the year, April 1, 1908, to March 31, 1909, the greatest acceleration was produced by the earthquake of November 30, where the period was 10<sup>s</sup>, and the amplitude 125 $\mu$ . This gives an acceleration of 4.9 milligals or about the  $\frac{1}{200,000}$  that of gravity.

For the disastrous Messina earthquake of last December the following accelerations have been computed. Most of the weekly or monthly earthquake reports received from other stations do not give sufficient data to compute the acceleration:—

|              | Distance. | $T_e$ | $A$   | $\Delta g$ |
|--------------|-----------|-------|-------|------------|
|              | km.       | s.    | $\mu$ |            |
| Ottawa.....  | 7,200     | 16    | 18    | 3          |
| Granada..... | 1,700     | 12    | 750   | 21         |
| Graz.....    | 1,600     | 20    | 1,100 | 11         |
| Jena.....    | 1,400     | 19    | 3,000 | 33         |

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In closing this part of my report, on seismology, I desire to express the hope that at no distant day, quarters will be erected for the machine shop; for the operation of the machinery in the basement of the Observatory, as at present, is a menace to the satisfactory functioning of the seismograph.

#### TERRESTRIAL MAGNETISM.

In continuation of the systematic magnetic survey of Canada begun last year, stations were occupied during the past summer, mostly in British Columbia, and the observations were made by Mr. C. A. French. The stations occupied were: Ottawa, Agincourt, Winnipeg, Banff, Golden, Revelstoke, Sicamous, Clinton, Barkerville, Quesnel, Alexandria, Williams Lake, Bridge Creek, Ashcroft, Spence's Bridge, Nicola, North Bend, Agassiz, Vancouver, Victoria and Nanaimo. The magnetic observations were all made in a tent, carried along for the purpose. Instruments used were: Tesdorpf magnetometer 1977, Dover Dip circle 145, Dent Mean Time chronometer 511, and a six-inch Troughton-Simms theodolite for azimuth, latitude and time observations.

In order that the observations of the elements of terrestrial magnetism in different parts of the earth may be strictly inter-comparable, it is essential that the constants of the instruments employed be referred to standard instruments, preferably at basal stations. By such comparisons, repeated from time to time, say at the beginning and end of the season of field work, one is enabled to give a homogeneity and confidence to the results which would otherwise be lacking, and would militate against their value for incorporation in the general discussion of the difficult problems presented by terrestrial magnetism.

There are several departments of physical investigation in which little progress has been made during the last fifty years in getting at the fundamentals underlying the elements involved. One of them is terrestrial magnetism. In 1904 the Carnegie Institution of Washington undertook to attack the problem in a comprehensive manner, especially in supplying magnetic data for the accessible regions of the world not before occupied, and more particularly to make a systematic magnetic survey of the various oceans, for which purpose a specially built non-magnetic vessel, the *Carnegie*, has been built and which was recently launched at Brooklyn. This work, combined with the Solar Research at Mt. Wilson, also under the auspices of the Carnegie Institution, should in the near future unravel some of the mysteries that have hitherto enshrouded that subtle force or energy—Terrestrial Magnetism.

Toronto is and has been one of the principal magnetic stations in the world, although the location of the instruments now, is not where the original ones were mounted. This change in 1898 to Agincourt, some 10 miles distant, was necessitated through the introduction of the electric cars in Toronto. Since beginning our systematic magnetic survey of Canada complete sets of magnetic observations—declination, inclination and horizontal intensity—have always been made with our field instruments at Agincourt and compared with the results of the standard instruments there, thereby standardizing the former. A similar comparison was made with our Tesdorpf magnetometer 1977 through the kindness of Dr. L. A. Bauer, Director of the Department of Terrestrial Magnetism, Carnegie Institution, at Washington, in April, 1908, with results practically identical with those at Agincourt.

For further comparisons, and more particularly for the comparison of different magnetic instruments, there has been erected during the past year on the Observatory grounds here, a magnetic hut, an illustration No. 1, thereof, accompanying this report. Its dimensions are 10 x 15 feet. It is scarcely necessary to say that no iron or steel of any description was used in the construction. The nails are all copper; hinges, &c., of brass, all tested for non-magnetism before use. The two pillars for mounting the instruments are solid cedar posts surmounted by brass plates 11¼ inches

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in diameter, which are grooved with three diameters, dividing the surface into sectors of  $60^\circ$ , for the footscrews of the instruments. When observations are made at night, petroleum is used for illumination. There is a permanent azimuth mark about a quarter of a mile distant. The Observatory grounds are just outside of the city limits and the vicinity is fairly free from traffic. The nearest approach of an electric car line to the magnetic hut is 1,492 feet (455 m.). The cars run from 6 a.m. to 12 p.m. on this line. In order to test whether the current of the line exercised a magnetic influence at the hut, observations were made for three days during the 24 hours for declination. There was no effect noticeable during the day-time when the cars were running, and for different positions of the cars on the line with reference to the hut and power station; nor for the time after midnight. The change in declination for each 24 hours followed the general daily curve of eastern and western elongation. Further on will be found the record of these observations. In the future, observations will be made here with the field instruments at the beginning and close of the season's work.

The following 'Memorandum for Magnetic Observations, 1908,' was issued to the observer:—

In the selection of new stations regard should be had for future occupation for the same points.

The vicinity of trolley lines should be avoided; the magnetic station should be at least a mile from the line.

The station selected is to be connected by linear measure with established corners of lots or intersections of streets, so that it may be accurately re-established at any future time. The azimuth of two or more well recognized objects from the station is to be obtained, either by observation on the sun at about 9 a.m. or 3 p.m., or on Polaris, the former by observing the altitude, circle right and circle left, and the latter by noting the sidereal time when sighting on Polaris, circle right and circle left.

The nature of the ground, whether there are any rock exposures, and surrounding topographic features are to be noted.

A sketch is to be made for each station, showing its relative position, and that of the astronomic meridian.

The order of the observations in general are:—

1. Azimuth.
2. Declination.
3. Dip.
4. Oscillation.
5. Deflection.
6. Deflection.
7. Oscillation.
8. Dip.
9. Declination.

Suspension of weight and removal of torsion for fibre declinometer require particular attention.

The mean of the times for dip, oscillations and deflections will be approximately the same when observing in the above order.

The observations are to be entered on the forms supplied.

Before leaving a station all the observations are to be reduced, with a sufficient degree of accuracy to ensure their reliability.

On your way west you will go via Toronto, and at Agincourt (the Magnetic Observatory) take a full set of observations with both the Tesdorpf and Dover, for the latter especially to obtain the value of  $\Delta$ , not forgetting to note temperatures throughout all the observations. Particular attention will be paid to the determination of the declination and the constant of correction for the declination magnet, 10.

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After all the observations have been satisfactorily made, you will proceed to Winnipeg and re-occupy the Carnegie Institution station in the park, the description of the station is hereto attached, also the former magnetic values. The azimuths given will be re-determined, and a full set of satisfactory magnetic observations taken.

Similarly Banff will be occupied, the necessary data are also attached.

The names of the other stations to be occupied are appended:—Golden, Revelstoke, Sicamous, Ashcroft, Clinton, Bridge Creek, Williams Lake, Alexandria, Quesnel, Barkerville, Spence's Bridge, Nicola, North Bend, Agassiz, Vancouver, Victoria, Nanaimo (Departure Bay).'

*Description of Stations occupied.*

Ottawa.—The station (not the magnetic hut) was situated in the southeastern part of the observatory grounds; it was 81 feet from the easterly limit and 53 feet from the southerly limit of the grounds. This station was occupied by the Carnegie Institution in October, 1906, and in 1907-1908 by our observers. It is now abandoned owing to the erection of the Director's house nearby. The reference object was the flag-staff on the central tower of the Parliament Buildings. True bearing, N. 16° 59'.0 W.

Agincourt.—The magnetic observatory.

Winnipeg.—Same station as occupied by the Carnegie Institution in 1906. It is in River Park, about half a mile east of park entrance, in the first cleared space beyond the grove of small trees that surround the entrance. It is about 15 paces from the top of the north bank of the Red river and in line of the fence bounding the buffalo pasture on the side adjacent to the river. It is about 330 feet southwest of the south corner of the pasture. Two grain elevators in the distance, and a small red barn in the pasture are seen nearly in line from the station. A red water tank is seen near the elevators and a little to the west of the barn. The following true bearings were determined:—

|   |                    |
|---|--------------------|
| Smokestack near International Elevator C. . . . . | 39° 18'.8 E. of N. |
| Pole on the red water tank. . . . .               | 23° 40'.0 E. of N. |
| West gable of a large white house. . . . .        | 47° 28'.6 E. of N. |

Banff.—The station is the same as that occupied by the Carnegie Institution in 1907. It is in the grounds of the National Park Museum, 292 feet south-southwest of the southwest corner of the museum building, midway between, and in line with, the two small spruce trees near the north bank of Bow river and nearest to a pen used at present for ducks. The point was marked by a round pine stake (about two inches in diameter and about eight inches long) driven flush with the surface. The stake is 67½ feet from the northeast corner of the duck pen and 93½ feet from the southeast corner, and is about 10 feet north of bank of river, and furthermore about in line with the west side of a one-story building in the rear of the Canadian Pacific Railway Museum on the north bank of the Bow river. The bearings of the following objects were obtained:—

|  |                    |
|--|--------------------|
| Meteorological Observatory, Sulphur Mt. anemometer pole, 8° 07'.2 W. of S. |                    |
| Sanitarium hotel, bottom of flagstaff, east tower. . . . .                 | 27° 19'.2 E. of S. |

Golden.—The station (1908) is on the property of Mr. Alexander, in a clearing on the south bank of the Kicking Horse river. It is about 200 feet east of the roadbed of the proposed Kootenay railway, and is midway between the ends of that portion of the bank along which is a breakwater consisting of a layer of small trees. From the station the top of the Columbia hotel is visible above the wooden bridge over the Kicking Horse river, and the front of the Queens hotel is seen to the east of the fire-hall.

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The point is marked by a round wooden peg 2 inches in diameter, and projects about an inch above the ground. It is distant 190 feet 3 inches from the northeast corner of a vacant log house; 261 feet 9 inches northeast from the southeast corner of a lot, one side of which is on Calgary street and the other parallel to the Kootenay Railway road-bed, and 234 feet southeast from the northeast corner of a lot adjacent to the first mentioned one. True bearings of the following reference objects were obtained:—

|  |                 |
|--|-----------------|
| Bottom of pole on C. P. R. water tank. . . . . | N. 36° 51'.1 W. |
| Bottom of flagpole on Columbia hotel. . . . .  | N. 49° 35'.8 W. |
| Bottom of flagpole on Parson's store. . . . .  | N. 80° 03'.9 W. |

The magnetic observations were taken 13 feet 3 inches southeast from station and in line with pole on tank. The soil is gravel.

Revelstoke.—The station is located on the Athletic grounds in the southwest part of the town. It is about 45 paces east of the bank of the Columbia river. The top of the Catholic church may be seen a little to the left of the line joining the station with the Canadian Pacific Railway water tank. The station is marked by a peg 2" x 1½" driven flush with the ground, and is 71 feet 8 inches from the northeast corner of the grand stand and 68 feet from the southeast corner. The true bearings of the following reference objects were obtained:—

|   |
|---|
| Bottom of pole on west water tank on mountain side. N. 33° 28'.1 E. |
| Top of belfry on school. . . . . N. 6° 03'.8 W.                     |
| Bottom of pole on Court House. . . . . N. 18° 53'.7 W.              |

The magnetic observations were taken at a point 8 feet 3 inches southwest from station and in line with water tank.

Sicamous.—The station is located in a clearing on the south side of the Canadian Pacific Railway, and on the east side of the narrow part of Shuswap lake. The Canadian Pacific Railway hotel may be seen between the pump-house and the first telegraph pole to the west of the semaphore. It is almost directly in line with the north end of the Bellevue hotel. The spot is marked by a round post about 2 inches in diameter, driven so as to project 3 inches above ground. It is 18 feet 9 inches from a large poplar tree and southeast of it, and is 14 feet from another round post about 1½ inches in diameter, which is in line with the station and tree. It is 172 feet from the east end of the Canadian Pacific Railway bridge.

The true bearings of the following points were obtained:—

|  |
|--|
| Top of pyramid over east bay window, C.P.R. hotel. S. 67° 56'.7 W. |
| North end of peak of Bellevue hotel. . . . . S. 39° 39'.0 W.       |

The magnetic observations were taken 9 feet southeast from station and in line with Canadian Pacific Railway hotel.

Clinton.—The station is in the southeast part of the town in a field owned by Mr. Smith. It is on a slight elevation about 30 paces to the south of the road leading to the cemetery. It is marked by a brass nail in a fir stake 2" x 4", driven 18 inches into the ground and projects 7 inches. It is 143½ feet northwest of the post which marks the northwest corner of the cemetery, and 144 feet southwest from the south large gate-post.

The true bearings of the following reference objects were obtained:—

|  |
|--|
| Top of church tower, Indian reservation. . . . . S. 70° 07'.3 W.   |
| Pole on cottage, rear of Provincial Land Office. . N. 88° 18'.7 W. |
| Pole on cottage (Dr. Sanson's). . . . . N. 69° 30'.5 W.            |

The magnetic observations were taken 25 feet northeast from station and in line with spire on Catholic church.

Barkerville.—The station is in a small clearing on the west side of the road which leads from the south of the town. It is about 336 feet (by way of road) from the  
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bridge which crosses the ditch constructed for conveying water used for mining purposes, which is about 45 paces from the south end of the bridge which crosses the river (now dug). The station is marked by a brass tack in the top of a fir post 3" x 4" which projects 3 inches above the ground. It is 39 feet from the middle of the road and 37 feet from a spruce tree which is to the south of it, and in line with a point slightly to the east of the Presbyterian church.

The following true bearings were determined:—

|   |                 |
|---|-----------------|
| Pole on Fire Hall. . . . .                        | S. 72° 08'.7 W. |
| Pole on Masonic Hall. . . . .                     | N. 80° 32'.3 W. |
| West gable on belfry Presbyterian church. . . . . | N. 44° 59'.5 W. |

The magnetic observations were taken 12 feet east from the station and in line with the pole on the Fire Hall.

Quesnel.—The station is on government property, north of the town. It is about 518 paces from the ferry cable, and is marked by a brass tack in a fir post 2" x 4", driven so as to project 8 inches above ground. It is 15 feet from the bank of the Fraser river, and 76 feet 8 inches northwest from the corner post of the fence around a small field which is adjacent to the post office property. There are three clumps of spruce trees about 75 feet south, and are so situated that the Catholic church and post office may be seen between the easterly pair; the pole of Reid's store between the westerly pair; and the grist mill to the right of the westernmost one.

The following true bearings of reference objects were obtained:—

|  |                 |
|--|-----------------|
| Bottom of cross on church. . . . .         | S. 28° 10'.7 E. |
| Gable of wing of post office. . . . .      | S. 22° 54'.4 E. |
| Pole on Reid's store. . . . .              | S. 14° 47'.4 E. |
| Gable of ventilator on grist mill. . . . . | S. 2° 06'.9 E.  |

The magnetic observations were taken 8 feet northwest from station and in line with pole on Reid's store.

Alexandria.—The station is on a waste piece of land in the northwest corner of a field belonging to Mr. Anders. The field is on the west side of the government road opposite the post office and farm buildings, and borders on the Fraser river. It is marked by a brass tack in a fir post 5 inches in diameter, which projects 8 inches above ground. It is about 95 feet northeast from the end of the trail which leads to the post office landing; 56 feet from the bank, and 57 feet southeast from a forked tree. The soil is a layer of sandy loam over gravel.

The following true bearings of reference objects were obtained:—

|   |                 |
|---|-----------------|
| West chimney on Mr. Anders' house. . . . .          | S. 73° 20'.7 E. |
| Spire, Catholic church, Indian reservation. . . . . | S. 3° 30'.0 W.  |

The magnetic observations were taken 12 feet northwest from station and in line with west chimney on Mr. Anders' house.

Williams Lake.—The station is southwest of the town on property belonging to the Cariboo Trading Company. The point is marked by a brass nail in a fir post 4" x 4", which projects 7 inches above ground. It is about 132 paces west of the Government Road, and a line joining it with the centre of the school passes over the entire length of a fairly large irrigation ditch. A telegraph pole obscures the lower part of the pole on the top of the school. The station is 87 feet from the point where the ditch branches into two, one taking a northwest direction and the other a southwest one. The ground is covered with stones and bowlders. The soil is of a soft, black nature.



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The following true bearings of reference objects were obtained:—

|   |                 |
|---|-----------------|
| Top of north chimney on large frame house. . . . .                  | S. 22° 12' 0 E. |
| Top of small pole on school. . . . .                                | N. 88° 20' 5 E. |
| Bottom of pole on ventilator C. T. Co.'s barn. . . . .              | N. 7° 52' 5 E.  |
| Bottom of pole over bay-window, white house W.<br>of hotel. . . . . | N. 6° 38' 1 W.  |

The magnetic observations were taken 25 feet northwest from station and in line with chimney on large frame house.

Bridge Creek.—The station is located on property belonging to Stephenson Bros., and is on the south edge of a fir grove which is in a field to the northwest of the ranch buildings, being 145 feet from the point where the irrigation ditch passes under the fence adjacent to the Cariboo road, and about at right angles to it. It is marked by a brass nail in a fir post 4½" x 4", which projects 7 inches above ground.

The true bearings of the following reference objects were obtained:—

|  |                 |
|--|-----------------|
| N.W. corner of chimney on N. of dwelling house. . . . .    | S. 28° 30' 1 E. |
| Gable of house situated to S.W. of dwelling house. . . . . | S 14° 38' 9 E.  |
| Chimney on machine shop in open field. . . . .             | S. 14° 16' 4 W. |

The magnetic observations were taken 12 feet northwest from station and in line with the central reference object.

Ashcroft.—The station is the same as that occupied by the Carnegie Institution in 1907. The station is in a field in the southern part of the town, owned by the British Columbia Express Company. It is 100 feet east of the bank of the Thompson river, about 1,000 feet from the Canadian Pacific Railway track, and about 500 feet from the nearest building. The station is marked by a brass screw in the top of a fir post 3½" x 3½" x 30", set so as to project 11 inches above the ground.

The following true bearings were determined:—

|  |                    |
|--|--------------------|
| Presbyterian church spire. . . . .                                   | 0° 17' 8 W. of N.  |
| English church spire. . . . .  | 14° 36' 4 E. of N. |
| Corner of red house on hill. . . . .                                 | 45° 41' 5 E. of N. |
| Telegraph pole marked 48. . . . .                                    | 3° 19' 6 E. of S.  |
| Vertical edge of rock pinnacle on opposite bank<br>of river. . . . . | 12° 50' 2 W. of S. |

The magnetic observations were taken 14 feet west from the station and in line with the Presbyterian church spire.

Spence's Bridge.—The station is a little less than half a mile west of the railway station, in a field belonging to Mr. Clemes. It is marked by a brass nail in a fir post 4" x 4" projecting 12 inches above ground, and is 61 feet 5 inches from the north corner post of the cemetery and almost in line with the diagonally opposite post, and is 110 feet 7 inches from the east corner post and 115 feet from the west corner post. (The diagonals of the cemetery are almost N.-S. and E.-W.)

The following true bearings of reference objects were obtained:—

|   |                 |
|---|-----------------|
| Corner of post of water tank on mountain side. . . . .  | N. 42° 21' 8 W. |
| Centre of circle on white cross (being headstone<br>on grave in cemetery on opposite side of river. . . . . | N. 11° 27' 4 W. |
| Pole on C. P. R. water tank. . . . .  | N. 64° 31' 6 E. |
| Bottom of post marked 'Yard Limit' on C.P.R. . . . .  | S. 27° 47' 6 W. |

The magnetic observations were taken at a point 25 feet west from station, and in line with pole on Canadian Pacific Railway water tank. Soil, loose sand and gravel.

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Nicola.—The station is opposite the Canadian Pacific Railway station in a field owned by Mr. House. It is marked by a brass nail in a fir post 2" x 4", projecting 7 inches above ground. The point is about 165 paces southwest of the end of the 'Y,' 62 feet east of a small irrigation ditch and 22 feet north of a line joining the bottom of the north row of stakes in the fence along the south boundary of the field.

The following true bearings of reference objects were obtained:—

|   |                 |
|---|-----------------|
| Gable end C. P. R. station. . . . .                             | N. 33° 35'.7 E. |
| Gable end C. P. R. engine shed. . . . .                         | N. 49° 54'.4 E. |
| Vertical edge of large boulder on mountain side. . . . .        | N. 86° 03'.0 E. |
| Chimney on south wing of house (this wing painted red). . . . . | S. 2° 55'.8 W.  |
| Gable of large red barn, about a mile distant. . . . .          | S. 34° 30'.5 W. |

The magnetic observations were taken 12 feet northeast from station, and in line with chimney on house. Soil, fine gravel.

North Bend.—The station is southwest of the town on the property of Mr. Phinister. It is on a waste piece of land beyond the first enclosure at the rear of the post office, and is about 650 feet from the Canadian Pacific Railway tracks. It is marked by a brass nail in a fir post 4" x 4", projecting 12 inches above ground. The point where the line through the station and the pole on the Canadian Pacific Railway water tank, intersects the continued line of the straight rail fence running north-westerly from the northwest corner of the post office is 38 feet from the station, and 86 feet from the end of the fence.

The following true bearings of reference objects were obtained:—

|   |                 |
|---|-----------------|
| Pole on C. P. R. water tank. . . . .                    | N. 25° 46'.2 E. |
| Small pole on south end of Mountain View hotel. . . . . | N. 46° 39'.9 E. |
| Small pole on west end of C. P. R. hotel. . . . .       | N. 58° 36'.9 E. |
| Bottom of cross on Catholic church. . . . .             | N. 88° 57'.1 E. |

The magnetic observations were taken 8 feet southwest from the station and in line with the pole on the water tank.

Agassiz.—The station is on the grounds of the Agassiz Agricultural Association. It is marked by a fir stake 2" x 4" driven flush with the ground. It is about 9 feet inside the race-track and is 165 feet 10 inches from the point in the east fence which is 167 feet from the northeast corner of the grounds, and 173 feet 10 inches from the point in the west fence which is 165 feet from the northwest corner of the grounds; the above distances to the east and west fences are in the same straight line.

The following true bearings of the reference objects were obtained:—

|   |                 |
|---|-----------------|
| Gable of porch in front of Presbyterian church. . . . .   | S. 27° 42'.0 W. |
| Gable of building in southwest corner of grounds. . . . . | S. 60° 49'.1 W. |
| Top of ventilator on hop barn. . . . .                    | N. 56° 17'.8 W. |

The magnetic observations were taken 31 feet northeast from the station and in line with the Presbyterian church. Soil, sandy loam.

Vancouver—Brockton Point.—The station is on the Government Lighthouse Reserve, on which is also the small Dominion Astronomical Observatory, used as a reference station for longitudes in British Columbia. It is 43 feet southerly from the southwest corner of the observatory building (office part), and eight feet due west from the produced line of the west end of building.

The following true bearing of the distant reference object was obtained:—

Steeple Catholic Indian mission church, North Vancouver, N. 50° 22'.6 E.  
The magnetic observations were taken at the above point.

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Victoria.—The Coast and Geodetic Survey station of 1903, as described in the C. & G. S. report of 1903, p. 1003, is as follows:—‘On the southeastern edge of the city, about 500 feet in a southwesterly direction from the flagpole in Dr. Millin’s yard (Dallas road and Dallas ave.) and 12 feet from the edge of the bluff overlooking the beach, between Holland point and Finlayson point. The station is marked by a 2” x 4” fir stub set flush with the ground. The flagpole in Dr. Millin’s yard bears  $65^{\circ} 03'.3$  east of true north; Race Rocks lighthouse bears  $43^{\circ} 18'.8$  west of true south.’

The following was received from the Carnegie Institution:—‘L. A. Bauer, of the Carnegie Institution, re-occupied this station in August, 1907, having found a fir stub projecting about 2 inches in the locality described above. However, two sets of azimuth observations gave for the azimuth of the first mark  $61^{\circ} 53'.1$  E. of N., and the second mark  $43^{\circ} 12'.3$  W. of S. Apparently there are two stubs in close proximity which it will be well to investigate if the station is re-occupied.’

A stub or peg was found projecting slightly above ground, evidently the one found by Dr. Bauer, of the Carnegie Institution. This peg, being badly decayed and broken, was replaced by one 4” x 4”, set flush with the ground.

The following true bearings of reference objects were obtained:—

|  |                          |
|--|--------------------------|
| Flagpole in Dr. Millin’s yard. . . . . | N. $64^{\circ} 51'.0$ E. |
| Race Rocks lighthouse. . . . .         | S. $43^{\circ} 13'.7$ W. |
| Buoy on Brotchy ledge. . . . .         | S. $72^{\circ} 20'.9$ W. |

The magnetic observations were taken 12 feet northeast from the station and in line with the lighthouse.

Nanaimo.—The station is on the side of Jesse island, which faces south and west. It is marked by a fir post which projects 18 inches above ground, and has a mound of earth and stones around it one foot in height. It is about 45 paces from the edge of the bank, and 160 paces from the cliff near the northwestern part of the island.

The following true bearings of reference objects were obtained:—

|   |                          |
|---|--------------------------|
| Pole on water tank at Breekin mine. . . . .                                   | S. $8^{\circ} 16'.7$ W.  |
| Chimney on west end of large white house at<br>northwest part of bay. . . . . | S. $86^{\circ} 01'.0$ W. |

The magnetic observations were taken 12 feet north from the station and in line with the pole on the water tank.

To occupy the stations between Ashcroft and Barkerville required a stage-drive of fully 500 miles.

On September 4, 1908, a magnetic storm manifested itself at Williams lake, as shown by the following readings for declination, magnet erect. The observations began at 16<sup>h</sup> 30<sup>m</sup> Pacific Standard Time; this would be equivalent to 0<sup>h</sup> 30<sup>m</sup> (a.m.) Greenwich Mean Time of September 5.

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| Vernier A. | Time. | Vernier A. | Time. | Remarks.  |
|------------|-------|------------|-------|---|
|            | h. m. |            | h. m. |   |
| 177° 04' 8 | 16 30 | 177° 22' 5 | 17 10 | Reference object A = 367° 36' 1.<br>B = 127° 36' 0.<br>Azimuth R. O. S 22° 11' 2 E. |
| 6.3        | 32    | 26.3       | 12    |   |
| 4.5        | 37    | 26.7       | 14    |   |
| 6.2        | 40    | 22.7       | 16    |   |
| 6.7        | 41    | 14.7       | 24    |   |
| 10.1       | 42    | 2.0        | 30    |   |
| 10.2       | 44    | 176° 56' 6 | 32    |   |
| 4.2        | 46    | 44.1       | 33    |   |
| 9.5        | 48    | 38.0       | 34    |   |
| 4.5        | 50    | 177° 10' 6 | 38    |   |
| 8.9        | 52    | 176° 36' 1 | 43    |   |
| 16.2       | 54    | 177° 00' 0 | 46    |   |
| 16.2       | 56    | 176° 52' 8 | 50    |   |
| 12.6       | 58    | 177° 10' 9 | 52    |   |
| 6.2        | 17 00 | 8.0        | 18 00 |   |
| 8.9        | 2     | 18.0       | 10    |   |
| 12.0       | 4     |            |       |   |
| 8.3        | 6     |            |       |   |
| 14.0       | 8     |            |       |   |

The needle was very unsteady also on the following day (5th). On September 11 and 12, while at Ashcroft, the needle showed unsteadiness. There was a fine auroral display on the evening and night of September 11.

The following readings of the declination magnet show the disturbances at Ashcroft on September 11, 1908.

Time—Pacific Standard—eight hours slow on Greenwich.

| Vernier A. | Time. | Remarks.  |
|------------|-------|---|
|            | h. m. |   |
| 243° 24' 8 | 14 01 | Reference object A = 215° 14' 3.<br>B = 35° 14' 2.<br>Az. of R. O. = N. 0° 17' 8 W. |
| 28.5       | 3     |   |
| 22.0       | 12    |   |
| 28.0       | 16    |   |
| 18.0       | 22    |   |
| 14.3       | 28    |   |
| 242° 54.6  | 43    |   |
| 58.5       | 46    |   |
| 243° 12.3  | 49    |   |
| 22.3       | 54    |   |
| 16.1       | 15 03 |   |
| 10.4       | 07    |   |

The range of declination at Williams lake on September 4, during the 1<sup>h</sup> 40<sup>m</sup> of observation, was 50' 6; and at Ashcroft on September 11, during 1<sup>h</sup> 04<sup>m</sup>, was 33' 9. On the afternoon of September 12, at Ashcroft, the magnet was quite steady. The observations at neither place were sufficiently continuous to obtain the extreme range, east and west, that the magnet attained.

The magnetic storms of those days were undoubtedly world-wide. Dr. C. Chree, of Kew, makes note of them in 'Nature,' of September 24, 1908. Referring to the declination, he says: 'The extreme easterly position was reached at about 2.53 a.m.,

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and the extreme westerly position at about 5.14 a.m. on September 12, the total range of declination being about  $1^{\circ} 27'$ . The movements on September 12 were the most rapid. Between 1.24 a.m. and 1.46 a.m. there was a westerly movement of about  $51'$ , followed in the course of the next eight minutes by an easterly movement of about  $35'$ , while between 2.58 a.m. and 3.28 a.m. there was a westerly movement of about  $53'$ . There were no large movements after 6 a.m.

TABLE I.

Stations occupied during 1908. The declinations are all reduced to 10:30 a.m. local time for the position of the average meridian for the day and place.

| Place.           | Latitude. | Longitude. | Year. | Month & Day. | Hour & Minute. | Declination. | Month & Day. | Hour & Minute. | Dip.    | Month & Day. | Hor. intensity C.G.S. Units. |      |
|------------------|-----------|------------|-------|--------------|----------------|--------------|--------------|----------------|---------|--------------|------------------------------|------|
| **Winnipeg, Man. | 49 52     | 97 09      | 1908  | July 16      | 10 30          | 13 61.2      | July 16      | 10 30          | 78      | July 16      | 13128                        |      |
|                  |           |            |       | " 17         | " 17           | 58.8         | " 17         | " 17           | 15.0    | " 17         | 13113                        |      |
|                  |           |            |       | " 18         | " 18           | 56.2         | " 18         | " 18           | 12.0    | " 18         | " 18                         | " 18 |
|                  |           |            |       | " 20         | " 20           | 57.1         | " 20         | " 20           | 11.9    | " 20         | " 20                         | " 20 |
| Banff, Alta.     | 51 10     | 115 37     | 1908  | July 22      |                | 26 6.8       | July 22      |                |         | July 22      | 15922                        |      |
|                  |           |            |       | " 23         | " 23           | 5.7          | " 23         | " 23           | 0.3     | " 23         | 15978                        |      |
|                  |           |            |       | " 24         | " 24           | 4.2          | " 24         | " 24           | 74 55.9 | " 24         | 15966                        |      |
|                  |           |            |       | " 24         | " 24           | 5.6          | " 24         | " 24           | 74 58.1 | " 24         | 15855                        |      |
| Golden, B.C.     | 51 18     | 116 57     | 1908  | July 27      |                | 26 3.8       | July 27      |                | 74 43.3 | July 27      | 16152                        |      |
|                  |           |            |       | " 28         | " 28           | 7.4          | " 28         | " 28           | " 28    | " 28         | " 28                         |      |
|                  |           |            |       | " 29         | " 29           | 1.6          | " 29         | " 29           | 74 42.2 | " 29         | 16167                        |      |
|                  |           |            |       | " 30         | " 30           | 1.2          | " 30         | " 30           | " 30    | " 30         | " 30                         |      |
| Revelstoke, B.C. | 51 0      | 118 12     | 1908  | Aug. 3       |                | 26 3.5       | Aug. 3       |                | 74 42.8 | Aug. 3       | 16180                        |      |
|                  |           |            |       | " 4          | " 4            | 48.6         | " 4          | " 4            | 74 13.6 | " 4          | 16499                        |      |
|                  |           |            |       | " 5          | " 5            | 47.6         | " 5          | " 5            | 17.5    | " 5          | 16521                        |      |
|                  |           |            |       | " 5          | " 5            | 49.5         | " 5          | " 5            | 17.2    | " 5          | 16483                        |      |
| Sicamous, B.C.   | 50 50     | 118 59     | 1908  | Aug. 6       |                | 25 48.6      | Aug. 6       |                | 74 16.1 | Aug. 6       | 16501                        |      |
|                  |           |            |       | " 7          | " 7            | 51.7         | " 7          | " 7            | 73 51.0 | " 7          | 16779                        |      |
|                  |           |            |       | " 8          | " 8            | 55.3         | " 8          | " 8            | 52.0    | " 8          | " 8                          |      |
|                  |           |            |       | " 8          | " 8            | 54.7         | " 8          | " 8            | 52.0    | " 8          | " 8                          |      |

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|---------------------|----|-----|----|------|---------|------|---------|-------|---------|---------|-------|
| Clinton, B.C.       | 51 | 121 | 35 | 1908 | " 9     | 53.0 | " 9     | 73    | 51.8    | " 9     | 16771 |
|                     |    |     |    |      | " 10    | 49.3 | " 10    | 16775 |         |         |       |
| Barkerville, B.C.   | 53 | 121 | 30 | 1908 | Aug. 13 | 26   | 25.3    | 73    | 28.9    | Aug. 13 | 17040 |
|                     |    |     |    |      | " 14    | 27.8 | " 14    | 17043 |         |         |       |
|                     |    |     |    |      | " 15    | 28.0 | " 15    |       |         |         |       |
|                     |    |     |    |      | " 16    | 26.6 | " 16    |       |         |         |       |
| Quesnel, B.C.       | 52 | 122 | 32 | 1908 | Aug. 22 | 28   | 5.8     | 74    | 57.5    | Aug. 22 | 15707 |
|                     |    |     |    |      | " 23    | 8.9  | " 23    | 15710 |         |         |       |
|                     |    |     |    |      | " 24    | 7.3  | " 24    |       |         |         |       |
|                     |    |     |    |      | " 25    | 7.3  | " 25    |       |         |         |       |
| Alexandria, B.C.    | 52 | 122 | 28 | 1908 | Aug. 26 | 28   | 18.1    | 74    | 51.3    | Aug. 26 | 15869 |
|                     |    |     |    |      | " 27    | 19.1 | " 27    | 15857 |         |         |       |
|                     |    |     |    |      | " 28    | 19.9 | " 28    |       |         |         |       |
|                     |    |     |    |      | " 28    | 19.0 | " 28    | 15863 |         |         |       |
| Williams Lake, B.C. | 52 | 121 | 56 | 1908 | Aug. 30 | 28   | 15.5    | 74    | 21.7    | Aug. 30 | 16401 |
|                     |    |     |    |      | " 31    | 15.4 | " 31    | 16375 |         |         |       |
|                     |    |     |    |      | Sept. 1 | 17.7 | Sept. 1 |       |         |         |       |
|                     |    |     |    |      | " 2     | 16.2 | " 2     | 16388 |         |         |       |
| Bridge Creek, B.C.  | 51 | 121 | 27 | 1908 | Sept. 3 | 28   | 54.1    | 74    | 12.5    | Sept. 3 | 16521 |
|                     |    |     |    |      | " 4     | 50.3 | " 4     |       |         |         |       |
|                     |    |     |    |      | " 5     | 52.6 | " 5     | 16515 |         |         |       |
|                     |    |     |    |      | " 6     | 54.2 | " 6     |       |         |         |       |
|                     |    |     |    |      | 28      | 52.8 | 74      | 12.3  |         |         |       |
|                     |    |     |    |      | 26      | 49.0 | 73      | 35.0  | Sept. 8 | 17202   |       |
|                     |    |     |    |      | 45.8    | " 9  | 73      | 33.2  | " 9     | 17142   |       |
|                     |    |     |    |      | 26      | 47.4 | 73      | 35.1  |         | 17172   |       |

\* Magnetic storm on afternoon of Sept. 4th.

\*\* Observations for Dip were taken with Dover Dip Circle 145. The standards on Tesdorpf Magnetometer 1477 prevented a reading being taken.

TABLE I—Continued.

| Place.                | Latitude. | Longitude. | Year. | Month<br>&<br>day. | Hour<br>&<br>minute. | Declination. | Month<br>&<br>day. | Hour<br>&<br>minute. | Dip.                                     | Month<br>&<br>day.               | Hor.<br>Intensity<br>C. G. S.<br>Units. |
|-----------------------|-----------|------------|-------|--------------------|----------------------|--------------|--------------------|----------------------|--|----------------------------------|---|
| *Ashcroft, B.C.       | 50 44     | 121 17     | 1908  | Sept. 11           | 10 30                |              | Sept. 11           | 10 30                | 73 (25 6<br>24 9<br>26 2<br>28 4<br>25 6 | Sept. 11<br>" 12<br>" 14<br>" 15 | 17214<br>17229<br>17222                 |
| Spence's Bridge, B.C. | 50 25     | 121 21     | 1908  | Sept. 16           |                      | 26 38.1      | Sept. 16           |                      | 72 59.3                                  | Sept. 16                         | 17379                                   |
|                       |           |            |       | " 17               |                      | 40.6         | " 17               |                      | 58.5                                     | " 17                             | 17361                                   |
|                       |           |            |       | " 18               |                      |              | " 18               |                      | 72 58.9                                  | " 18                             | 17270                                   |
| Nicola, B.C.          | 50 9      | 120 40     | 1908  | Sept. 19           |                      | 25 1.4       | Sept. 19           |                      | 72 54.7                                  | Sept. 19                         | 17546                                   |
|                       |           |            |       | " 20               |                      | 4.1          | " 20               |                      | 53.3                                     | " 20                             | 17546                                   |
|                       |           |            |       | " 21               |                      | 3.4          | " 21               |                      |  | " 21                             |   |
| North Bend, B.C.      | 49 52     | 121 27     | 1908  | Sept. 23           |                      | 25 3.0       | Sept. 23           |                      | 72 54.0                                  | Sept. 23                         | 17546                                   |
|                       |           |            |       | " 24               |                      | 48.6         | " 23               |                      | 72 33.4                                  | " 23                             |   |
|                       |           |            |       | " 25               |                      | 48.9         | " 24               |                      | 31.1                                     | " 24                             | 17964                                   |
|                       |           |            |       | " 26               |                      | 47.3         | " 25               |                      | 31.9                                     | " 25                             | 17980                                   |
|                       |           |            |       | " 26               |                      | 47.2         | " 26               |                      |  | " 26                             |   |
| **Agassiz, B.C.       | 49 15     | 121 45     | 1908  | Sept. 28           |                      | 25 48.0      | Sept. 28           |                      | 72 32.1                                  | Sept. 28                         | 17972                                   |
|                       |           |            |       | Oct. 1             |                      |              | Oct. 1             |                      | 71 34.9                                  | Sept. 28                         | 18923                                   |
|                       |           |            |       | " 2                |                      | 25 24.0      | " 1                |                      | 34.9                                     | Oct. 1                           | 18915                                   |
|                       |           |            |       | " 2                |                      | 23.2         | " 2                |                      | 34.9                                     | " 2                              | 18919                                   |
|                       |           |            |       | " 2                |                      | 23.6         | " 2                |                      | 71 34.9                                  | " 2                              |   |



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|----------------------------------|----|----|-----|----|------|--------------|----------|--------------|---------|--------------|-------|
| Vancouver, (Brookton Point) B.C. | 49 | 18 | 123 | 7  | 1908 | Oct. 5.....  | 25 21 0  | Oct. 5.....  | 71 39.5 | Oct. 5       | ..... |
|                                  |    |    |     |    |      | " 6.....     | 23 3     | " 6          | 71 41.4 | " 6          | ..... |
|                                  |    |    |     |    |      | " 7.....     | 21 3     | " 7          | 44 0    | " 7          | 18782 |
|                                  |    |    |     |    |      | " 8.....     | 24 4     | " 8          | 42 8    | " 8          | 18781 |
|                                  |    |    |     |    |      | 41.7         |          |              |         |              |       |
|                                  |    |    |     |    |      | 23 3         |          |              | 71 42.4 |              | 18782 |
| Victoria, B.C.<br>(C.I.S.)       | 48 | 25 | 123 | 21 | 1908 | Oct. 12..... | .....    | Oct. 12..... | 71 18.3 | Oct. 12..... | ..... |
|                                  |    |    |     |    |      | " 13.....    | 21 34 0  | " 13         | 49 8    | " 13         | 18787 |
|                                  |    |    |     |    |      | " 11.....    | 33 9     | " 11         | 20 0    | " 11         | 18789 |
|                                  |    |    |     |    |      |              | 24 34 0  |              | 19 9    | " 11         | 18763 |
|                                  |    |    |     |    |      | 15 1         |          | 71 19.3      |         | 18763        |       |
| Nanaimo, B.C.<br>(Jesse Island)  | 49 | 13 | 123 | 52 | 1908 | Oct. 17..... | 25 15 4  | Oct. 17..... | 71 19.3 | Oct. 17      | 18827 |
|                                  |    |    |     |    |      | " 18.....    | 15 1     | " 18         | 20 9    | " 17         | ..... |
|                                  |    |    |     |    |      |              | 25 15 3  |              | 20 2    | " 17         | 18827 |
|                                  |    |    |     |    |      |              | 12 49 1W |              | .....   |              | ..... |
| Ottawa, Ont.<br>(C.I.S.)         | 45 | 24 | 75  | 43 | 1908 | Nov. 2.....  | 12 49 1W | Nov. 2.....  | 75 41 9 | Nov. 2.....  | 15150 |
|                                  |    |    |     |    |      | " 3.....     | 47 5     | " 3.....     | .....   | " 3.....     | 15169 |
|                                  |    |    |     |    |      | " 26.....    | 48 9     | " 26.....    | .....   | " 26.....    | ..... |
|                                  |    |    |     |    |      |              | 12 48 5W |              | .....   |              | 15136 |
| Ottawa, Ont.<br>(Hut.)           | 45 | 24 | 75  | 43 | 1908 | Nov. 20..... | 12 50 3  | Nov. 20..... | .....   | Nov. 20..... | 15165 |
|                                  |    |    |     |    |      | " 23.....    | 50 2     | " 23.....    | .....   | " 23.....    | ..... |
|                                  |    |    |     |    |      | " 26.....    | 51 0     | " 26.....    | .....   | " 26.....    | 15149 |
|                                  |    |    |     |    |      | " 27.....    | .....    | " 27.....    | .....   | " 27.....    | ..... |
|                                  |    |    |     |    |      | 12 50 5W     |          | .....        |         | 15157        |       |

\* Magnetic storm Sept. 11th and 12th. Aurora Sept. 11th.  
 \*\* Magnetic storm Sept. 29th and 30th. Aurora Sept. 29th.

TABLE 11.

This table gives a resume of Table I, together with the values of the horizontal intensity observed with Dover 145.

1977—Tesdorpf Magnetometer.  
145—Dover Dip Circle.

| Place.                                    | Latitude. | Longitude. | Year. | Month & day.  | Declination. | Month & day.  | Dip. | Month & day. | Hor. force C. S. S. Units. | Instrument. |
|---|-----------|------------|-------|---------------|--------------|---------------|------|--------------|----------------------------|-------------|
| Winnipeg, Man., Carnegie Institution Sta. | 49 52     | 97 9       | 1908  | July 16-20    | 13 58.6      | July 17-18-20 | 78   | July 16-18   | 13121                      | 1977        |
|   |           |            |       |               |              | " 17          | 13.0 | " 17         | 13060                      | 145         |
| Banff, Alta., Carnegie Institution Sta.   | 51 10     | 115 37     |       | " 22-24       | 26 5.6       | " 23-24       | 74   | " 22-24      | 15955                      | 1977        |
|   |           |            |       |               |              | " 25          | 59.3 | " 25         | 15942                      | 145         |
| Golden, B. C.                             | 51 18     | 116 57     |       | " 27-30       | 26 3.5       | " 27-29       | 71   | " 27-29      | 16160                      | 1977        |
|   |           |            |       |               |              | " 28          | 42.8 | " 28         | 16142                      | 115         |
| Revelstoke, B. C.                         | 51 0      | 118 12     |       | Aug 3-4-5     | 25 48.6      | Aug 1-3-4     | 74   | Aug 1-3-4    | 16501                      | 1977        |
|   |           |            |       |               |              | " 5           | 16.6 | " 5          | 16158                      | 145         |
| Sicamous, B. C.                           | 50 50     | 118 59     |       | " 6-10        | 25 52.8      | " 6-7-8       | 73   | " 6-9        | 16775                      | 1977        |
|   |           |            |       |               |              | " 10          | 55.1 | " 10         | 16785                      | 145         |
| Clinton, B. C.                            | 51 6      | 121 35     |       | " 13-16       | 26 26.4      | " 14-15       | 73   | " 14-15      | 17042                      | 1977        |
|   |           |            |       |               |              | " 13          | 27.6 | " 13         | 17223                      | 145         |
| Parkerville, B. C.                        | 53 4      | 121 30     |       | " 22-24       | 28 7.3       | " 22-23       | 74   | " 22-23      | 15708                      | 1977        |
|   |           |            |       |               |              | " 21          | 57.6 | " 21         | 15694                      | 145         |
| Quesnel, B. C.                            | 52 59     | 122 32     |       | " 26-28       | 28 19.0      | " 26-27       | 74   | " 26-27      | 15863                      | 1977        |
|   |           |            |       |               |              | " 28          | 49.0 | " 28         | 15913                      | 145         |
| Alexandria, B. C.                         | 52 35     | 122 28     |       | Aug 30-Sept 1 | 28 16.2      | " 30-31       | 74   | " 30-31      | 16388                      | 1977        |
|   |           |            |       |               |              | Sept. 1       | 18.4 | Sept. 1      | 16468                      | 145         |
| *Williams Lake, (150 mile post) B. C.     | 52 6      | 121 56     |       | Sept. 3-5     | 28 52.8      | " 3-5         | 74   | " 3-5        | 16518                      | 1977        |
|   |           |            |       |               |              | " 5           | 12.4 | " 5          | 16507                      | 115         |
| Bridge Creek, (100 mile post) B. C.       | 51 39     | 121 27     |       | " 8-9         | 26 47.4      | " 8-9         | 73   | " 8-9        | 17172                      | 1977        |

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|---|----|----|-----|----|-------|------|----------|----|-------|----------|-----------|------|-------|------|---------|-------|------|
| Ashcroft, B.C., Carnegie Institution Sta. | 50 | 44 | 121 | 17 | ..... | "    | 11-15..  | 27 | 46.9  | "        | 11-12-14  | 73   | 26.1  | "    | 14-15   | 17222 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 26.8 | "     | 12.. | 17298   | 145   |      |
| Spence's Bridge, B.C.                     | 50 | 25 | 121 | 21 | ..... | "    | 17-18..  | 26 | 39.4  | "        | 17-18..   | 72   | 58.9  | "    | 16-17.  | 17370 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 57.6 | "     | 18.. | 17411   | 135   |      |
| Nicola, B.C.                              | 50 | 9  | 120 | 40 | ..... | "    | 19-21..  | 25 | 3.0   | "        | 19-20..   | 72   | 54.0  | "    | 19-20.. | 17546 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 53.4 | "     | 21.. | 17529   | 145   |      |
| North Bend, B.C.                          | 49 | 52 | 121 | 27 | ..... | "    | 23-26..  | 25 | 48.0  | "        | 23-25..   | 72   | 32.1  | "    | 24-25.. | 17972 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 31.2 | "     | "    | 17946   | 145   |      |
| Agassiz, B.C.                             | 49 | 15 | 121 | 45 | ..... | Oct. | 1-2..    | 25 | 23.6  | Sept. 28 | Oct. 1, 2 | 71   | 34.9  | Oct. | 1-2..   | 18919 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 36.1 | Sept. | 28.. | 18902   | 145   |      |
| Vancouver, B.C., (Brookton Point)         | 49 | 18 | 123 | 7  | ..... | "    | 5-8..    | 25 | 23.3  | Oct.     | 6-8       | 71   | 42.4  | Oct. | 7-8     | 18782 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 13.7 | "     | 3..  | 18669   | 145   |      |
| Victoria, B.C., Carnegie Institution Sta. | 48 | 25 | 123 | 21 | ..... | "    | 13-14..  | 24 | 34.0  | "        | 12-14     | 71   | 19.3  | "    | 13-14   | 18763 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 17.0 | "     | 10.. | 18779   | 145   |      |
| Nanaimo, B.C., (Jesse Island)             | 49 | 13 | 123 | 52 | ..... | "    | 17-18..  | 25 | 15.3  | "        | 17-18..   | 71   | 20.2  | "    | 17..    | 18827 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          | "         | 21.5 | "     | 18.. | 18786   | 145   |      |
| Ottawa, Ont., Carnegie Institution Sta.   | 45 | 24 | 75  | 43 | ..... | Nov. | 2-5-26   | 12 | 48.5W | Nov.     | 2..       | 75   | 41.9  | "    | 2-5..   | 15156 | 1977 |
|   |    |    |     |    |       |      | "        |    |       |          |           |      |       |      |         |       |      |
| Ottawa, Ont., (Hub)                       | 45 | 24 | 75  | 43 | ..... | "    | 20-23-26 | 12 | 50.5W |          |           |      |       | Nov. | 23-27   | 15137 | 1977 |

\* Magnetic storm Sept. 4th, 1910.  
 † " " " Sept. 11th and 12th., Anroora, Sept. 11th.  
 ‡ " " " " 29th and 30th., " " 29th.  
 § The "Dip" at Winnipeg was obtained with Dover Dip Circle 115.

In the report of 1898 the Department of the Interior published the magnetic data that had been obtained in connection with the survey and exploration of Dominion lands between the years 1881 and 1890. The declination was generally obtained by means of a long compass needle attached to the lower plate of a transit-theodolite within a narrow box, fitting into a groove, while inclination and total force (intensity) were obtained by a Kew Dip Circle, the constants of which had been determined at the Toronto Magnetic Observatory.

The observations extended in latitude from Port Arthur  $48^{\circ} 26'$  to Lake Lindeman  $59^{\circ} 47'$  near the head waters of the Yukon, and in longitude from Eastmain,  $78^{\circ} 29'$ , to Lake Lindeman,  $135^{\circ} 05'$ . The number of stations distributed over this vast area was 204, but by no means uniformly distributed, the most of them lying along exploratory routes.

In 1883 Sir J. H. Lefroy published his observations in Canada made in 1843-44, covering 314 stations.

These two publications are the only ones up to the present of extended magnetic observations in Canada, except the publications of the United States Coast and Geodetic Survey, which are partly based on the above data and partly on the observations by officers of that survey.

It is thought desirable to bring together the whole of the magnetic data available in our office and publish it.

For the present it is considered more desirable to publish the actual observations than to defer until a reduction has been made to a uniform epoch. The data for most of the stations and many areas, are far too limited to justify such a reduction by themselves. The principal difficulty encountered in reducing to a common epoch, or in reducing from one epoch to another is that of secular variation. Although the existence of secular variation has been known since the days of Gellibrand, 275 years ago, yet its explanation is still unknown. Here is a case where nature absolutely refuses to allow itself to be put in a straight jacket of mathematical formulæ, but instead, pursues its apparently erratic course to the dismay of investigators. As Huxley has well said, that 'our mathematical skill is no guarantee of the quality of the grist,' adding that, 'as the grandest mill will not extract wheat flour from peascods, so pages of formulæ will not get a definite result out of loose data.'

The element, for which for practical purposes, information is from time to time required is the declination, due to the fact that nearly all the older surveys were made with chain and compass, so that in re-tracing or re-establishing an old survey line it is frequently necessary to know the amount of change of the position of the needle, in short, the secular variation for the interval of time. It is impossible to give a general formula from which to deduce the information desired. However, as the original compass survey was at best but an approximation, the secular variation deduced from some empirical formula covering the area under consideration will furnish data for the re-establishment of old survey lines run by compass with a degree of accuracy quite in keeping with the bearing of the original line. The application of secular variation is most applicable in the re-survey of 'timber limits,' where seldom a definite line of reference is available, of which the magnetic bearing at the time of the timber limit survey is given. Such limits generally border a stream or river, the direction of the other sides was mostly made dependent upon the general course or trend of the river. What was accepted at the time by the surveyor as the general course of the river it is impossible subsequently to determine, so that laying off angles with a transit from the river is out of the question, and we fall back on the compass line as corrected for secular variation for re-determining the boundaries of an old timber limit.

For the re-establishment of lot lines in eastern Canada, which was originally almost completely wooded, and where the original surveys were all made by chain and compass, the case is somewhat different. Here 'concessions' and 'side-roads' were

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the governing factors for the directions of the lot lines, and these former ones were the ones to be opened up first, before the blazes and marks of the original survey were lost and obliterated. Hence in re-running a lot line at present with a compass, one would need only observe the actual magnetic bearing of the governing concession line and apply the difference between it and its original bearing, to the original bearing of the lot line for obtaining its present magnetic direction. Nowadays, however, no surveyor's outfit in Canada is confined to a compass, in fact this instrument on Jacob's staff is obsolete, and the transit-theodolite is used, with which the proper angle would be turned off from the governing line for the lot line irrespective of the magnetic bearing of either.

There are other cases besides those of timber limits and original lot lines. These refer to subdivision lines abutting on original lot lines or other subdivision lines, all run at different periods, the maps thereof showing the magnetic bearing for each line when surveyed, which for a closed figure is, on the face of it, a mathematical impossibility. Such cases, personally well known to the writer, tax the ingenuity and skill of the surveyor, armed with theodolite, compass, secular variation, 'deeds' and plans, to do justice to all parties and lines concerned. It may be noted that while the secular variation in general is but a few minutes per year, the daily or diurnal variation is several times that amount. This indicates the importance of noting the time of day when an observation for declination is taken. A disregard of this precaution is equivalent to probably several years displacement theoretically of the year of observation. Conversely, most of our old survey data do not include the time of day when the direction of a line had a certain magnetic bearing, hence with meagre data with reference to different periods or years for a given place, as is the case for many of the stations hereafter given, it is obvious that in the attempt to deduce secular variation therefrom or a general expression for the declination at a given time, we cannot hope to attain more than a rude approximation; much more so when we wish to carry the determination beyond the limits of observation, that is, when we extrapolate instead of interpolate.

The diurnal variation reaches its extreme value eastward at about 8 a.m. and westward at about 1.30 p.m., crossing the average magnetic meridian for the place at about 10.30 a.m. This applies to the southerly part of Canada; in the higher latitudes, the time interval of elongation from the magnetic meridian is increased.

### *Stations.*

In the grouping of our stations, lying between the Atlantic and Pacific oceans and extending to Hudson bay and the Arctic ocean, it was considered more desirable to group them by political divisions as far as possible, *i.e.*, by provinces, than to bound the groups by parallels of latitude and meridians of longitude. In any case we will have contiguous stations falling into different groups. To the general public, to the surveyor, the engineer, the grouping by provinces will be more acceptable than any other scheme.

Canada has hence been divided into the following groups:—

Quebec and Labrador; Nova Scotia, including Cape Breton and Prince Edward Island; Ontario; Hudson bay and surrounding territory; Manitoba; Saskatchewan and Alberta; British Columbia; and Yukon and Northwest Territories, these latter extending from the 60th parallel to the Arctic ocean and west of Hudson bay.

In each of these groups the stations have been arranged in order of longitude, so that, in general, the tabulation will show, considering west declination positive and east declination negative, an algebraic decrease of declination with an increase of longitude.

The agonic line, or line 'without an angle,' *i.e.*, the line joining the points at which the direction of the magnetic meridian is coincident with that of the astronomic

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meridian, passes at the present time somewhat to the west of Schreiber on the Canadian Pacific Railway, and west of Windsor. Places to the east of it have west declination, and those to the west have east declination.

In the table of compiled magnetic elements,—declination, inclination, horizontal and total intensities,—the column 'Observer' gives the source of the information, indicated by abbreviation, when the observer himself is not given.

The data opposite to the abbreviations C.I., C.S. and L.S., are taken from

TABLE  
MAGNETIC  
NOVA

C. I.—Carnegie Institution.

| Place.                        | Latitude. |      | Longitude. |      | Year.             | Month and day.               | Hour and minute. | Declination. |        |
|-------------------------------|-----------|------|------------|------|-------------------|------------------------------|------------------|--------------|--------|
|                               | °         | '    | °          | '    |                   |                              |                  | °            | '      |
| Louisburg.....                | 45        | 53·0 | 60         | 00·0 | 1862              |                              |                  |              |        |
| Cape Breton.....              | 46        | 16·0 | 60         | 08·0 | 1862              |                              |                  |              |        |
| Sydney, Cape Breton.....      | 46        | 09·0 | 60         | 11·0 | 1905 <sup>5</sup> |                              |                  | 24           | 48 W   |
| " ".....                      | 46        | 08·6 | 60         | 11·6 | 1881              | Oct. 21, 22.                 |                  | 25           | 11·8 " |
| " ".....                      | 46        | 08·5 | 60         | 11·8 | 1896              | July 11, 13.                 |                  | 24           | 53·4 " |
| " ".....                      | 46        | 06·7 | 60         | 12·0 | 1907              | { Oct. 30, 31.<br>Nov. 1, 2. |                  | 25           | 27·9 " |
| " ".....                      | 46        | 09·0 | 60         | 15·0 | 1905 <sup>7</sup> |                              |                  | 25           | 09·6 " |
| Arichat, Isle Madame.....     | 45        | 30·5 | 61         | 01·3 | 1881              | Oct. 26                      |                  | 23           | 25·9 " |
| Isle Madame, Cape Breton..... | 45        | 28·0 | 61         | 03·0 | 1862              |                              |                  |              |        |
| Mulgrave.....                 | 45        | 35·1 | 61         | 22·5 | 1907              | Nov. 5, 6.                   |                  | 24           | 13·2 " |
| Antigonish.....               | 45        | 35·6 | 61         | 59·2 | 1907              | " 8, 9.                      |                  | 23           | 25·4 " |
| Pictou.....                   | 45        | 38·0 | 62         | 43·5 | 1907              | Oct. 25, 26, 28.             |                  | 23           | 01·9 " |
| Truro.....                    | 45        | 20·2 | 63         | 15·0 | 1907              | " 22, 23, 24.                |                  | 21           | 50·7 " |
| Point Pleasant.....           | 44        | 37·0 | 63         | 31·0 | 1904 <sup>7</sup> |                              |                  | 21           | 02·0 " |
| " ".....                      | "         | "    | "          | "    | 1905 <sup>7</sup> |                              |                  | 20           | 47·3 " |
| Halifax.....                  | 44        | 40·0 | 63         | 35·0 | 1834              |                              |                  |              |        |
| " ".....                      | "         | "    | "          | "    | 1837              |                              |                  |              |        |
| " ".....                      | "         | "    | "          | "    | 1838 <sup>5</sup> |                              |                  |              |        |
| " ".....                      | "         | "    | "          | "    | 1847 <sup>5</sup> |                              |                  |              |        |
| " ".....                      | "         | "    | "          | "    | 1873              |                              |                  |              |        |
| " ".....                      | "         | "    | "          | "    | 1879              | Sept. 8-10.                  |                  | 20           | 43·3 " |
| " ".....                      | "         | "    | "          | "    | 1881              |                              |                  |              |        |
| " ".....                      | 44        | 39·5 | 63         | 35·0 | 1896              | July 6, 7.                   |                  | 20           | 38·6 " |
| Pugwash.....                  | 45        | 50·2 | 63         | 40·5 | 1907              | Oct. 19, 20, 21.             |                  | 22           | 39·0 " |
| Black Point.....              | 44        | 38·0 | 64         | 01·0 | 1905 <sup>7</sup> |                              |                  | 21           | 01·0 " |
| Windsor.....                  | 44        | 59·6 | 64         | 08·4 | 1847              |                              |                  |              |        |
| " ".....                      | 44        | 59·6 | 64         | 08·4 | 1881              | Nov. 22.                     |                  | 20           | 42·3 " |
| Kentville.....                | 45        | 12·0 | 64         | 46·0 | 1847              |                              |                  |              |        |
| Annapolis.....                | 44        | 44·5 | 65         | 31·1 | 1881              | Nov. 14, 15, 16.             |                  | 19           | 26·8 " |
| Weymouth.....                 | 44        | 24·4 | 65         | 59·8 | 1881              | " 11.                        |                  | 18           | 43·4 " |
| Yarmouth.....                 | 43        | 49·9 | 66         | 07·2 | 1881              | " 7, 8.                      |                  | 17           | 49·4 " |

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'United States Magnetic Tables and Magnetic Charts for 1905,' by L. A. Bauer, and published by the United States Coast and Geodetic Survey, 1908.

C.I. refers to observations made by officers of the Carnegie Institution.

C.S. refers to observations made or published by the United States Coast and Geodetic Survey.

L.S. refers to observations by the United States Lake Survey.

III.

RESULTS.

SCOTIA.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.             |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|-----------------------|
|                |                  | 76 00.0 |                |                  |              |               |              | Shadwell.             |
|                |                  | 76 03.0 |                |                  |              |               |              | "                     |
|                |                  | 74 25.0 |                |                  | 1560         |               |              | French Navy.          |
| Oct. 21, 22.   |                  | 75 10.0 | Oct. 21, 22.   |                  | 1547         | 5918          |              | S. W. Very.           |
|                |                  | 74 38.6 |                |                  |              | 5842          |              | G. R. Putnam.         |
|                |                  | 74 16.8 |                |                  | 1563         | 5768          |              | White-Fraser.         |
|                |                  | 74 23.7 |                |                  | 1566         |               |              | C. I.                 |
| Oct. 26.       |                  | 74 43.0 | Oct. 26.       |                  |              | 6007          |              | S. W. Very.           |
|                |                  | 75 31.0 |                |                  |              |               |              | Shadwell.             |
|                |                  | 73 53.6 |                |                  | 1611         | 5807          |              | White-Fraser.         |
|                |                  | 74 17.9 |                |                  | 1596         | 5899          |              | "                     |
|                |                  | 74 31.2 |                |                  | 1577         | 5910          |              | "                     |
|                |                  | 73 52.5 |                |                  | 1618         | 5827          |              | "                     |
|                |                  | 73 58.0 |                |                  | 1624         |               |              | N. S. Instit. Science |
|                |                  | 73 59.6 |                |                  | 1619         |               |              | C. I.                 |
|                |                  | 75 33.0 |                |                  |              | 5966          |              | E. Home.              |
|                |                  | 74 58.0 |                |                  |              |               |              | "                     |
|                |                  | 74 45.0 |                |                  |              |               |              | Estcourt.             |
|                |                  | 75 37.0 |                |                  |              | 6026          |              | Keily.                |
| May 13, 15, 16 |                  | 74 48.2 | May 13, 15, 16 |                  |              | 5954          |              | Macleau & Bromley     |
| Sept. 8-10.    |                  | 74 39.2 | Sept. 8-10.    |                  |              | 6013          |              | J. B. Baylor.         |
| Nov. 2.        |                  | 74 29.0 | Nov. 2.        |                  |              | 5962          |              | S. W. Very.           |
|                |                  | 73 54.0 |                |                  | 1632         | 5885          |              | G. R. Putnam.         |
|                |                  | 74 48.8 |                |                  | 1544         | 5895          |              | White-Fraser.         |
|                |                  | 73 59.9 |                |                  | 1617         |               |              | C. I.                 |
|                |                  | 75 41.0 |                |                  |              |               |              | G. W. Keily.          |
| Nov. 21, 22.   |                  | 74 49.0 | Nov. 21, 22.   |                  |              | 6026          |              | S. W. Very.           |
|                |                  | 75 46.0 |                |                  |              |               |              | G. W. Keily.          |
|                |                  | 74 53.0 | Nov. 14, 15.   |                  |              | 6059          |              | S. W. Very.           |
| Nov. 10.       |                  | 74 45.0 | Nov. 10.       |                  |              | 6068          |              | "                     |
| " 7            |                  | 74 35.0 | Nov. 8.        |                  |              | 6026          |              | "                     |

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TABLE  
MAGNETIC

QUEBEC—

C. I.—Carnegie Institution.  
C. S.—Coast Survey.

| Place.   | Latitude. | Longitude. | Year.  | Month and day.              | Hour and minute. | Declination. |
|--|-----------|------------|--------|-----------------------------|------------------|--------------|
| Battle Harbour, Caribou is-<br>land, Labrador..... | 52 16 3   | 55 34 5    | 1881   | Sept. 5,6,7,8.              |                  | 37 12 7W     |
| Grady, Labrador.....                               | 53 48 2   | 56 25 3    | 1881   | Aug. 3,4.....               |                  | 39 03 8 "    |
| Turnavik, Labrador.....                            | 55 14 9   | 59 19 0    | 1881   | July 28,29..                |                  | 40 22 8 W    |
| " .....  | 55 14 6   | 59 20 3    | 1896   | July 20.....                |                  | 38 26 4 "    |
| Nain, Labrador.....                                | 56 32 7   | 61 40 7    | 1881   | Aug. 11 to 18               |                  | 44 50 2 "    |
| Gaspé Basin.....                                   | 48 50 0   | 64 30 0    | 1832   |                             |                  |              |
| Rivière du Loup.....                               | 47 51 0   | 69 25 0    | 1876   |                             |                  |              |
| " .....  | 47 50 0   | 69 33 0    | 1906 7 |                             |                  | 20 38 7W     |
| Brandypot island.....                              | 47 53 0   | 69 42 0    | 1830   |                             |                  |              |
| St. Thomas, Montmagny.....                         | 46 59 0   | 70 33 0    | 1876   | Aug. 24,25 ..               |                  | 17 50 1W     |
| Megantic .....                                     | 45 34 4   | 70 53 2    | 1907   | Sept. 20,21,<br>23, 24..... |                  | 16 33 2 "    |
| Alphonse .....                                     | 48 21 0   | 70 54 0    | 1906 7 |                             |                  | 21 54 0 "    |
| Tring Jct.....                                     | 46 15 5   | 71 00 0    | 1907   | Sept. 26, 27.               |                  | 17 22 2 "    |
| Chicoutimi.....                                    | 48 25 0   | 71 03 0    | 1906 7 |                             |                  | 20 17 1 "    |
| Quebec.....  | 46 48 6   | 71 13 3    | 1845   |                             |                  |              |
| " .....  | "         | "          | "      | "                           |                  |              |
| " .....  | 46 48 0   | 71 14 0    | 1906 2 |                             |                  | 17 53 0W     |
| " .....  | 46 49 5   | 71 14 2    | 1842   | Sept. 1.....                |                  | 14 12 0 "    |
| " .....  | 46 48 4   | 71 14 5    | 1859   | July 19.....                |                  | 16 17 0 "    |
| " .....  | "         | "          | 1879   | Sept. 16, 19.               |                  | 17 13 7 "    |
| Béancour .....                                     | 46 22 0   | 71 33 0    | 1876   | Aug. 17,18..                |                  | 15 43 5 "    |
| Sherbrooke.....                                    | 45 23 9   | 71 56 2    | 1907   | Sept. 14,16,<br>17, 18..... |                  | 15 59 9 "    |
| Richmond Jct.....                                  | 45 41 0   | 72 03 0    | 1876   | Aug. 15.....                |                  | 16 59 6 "    |
| Peribonka.....                                     | 48 46 0   | 72 05 0    | 1906 7 |                             |                  | 20 55 7 "    |
| Stanstead.....                                     | 45 02 0   | 72 07 0    | 1842   |                             |                  |              |
| Kingsey.....                                       | 45 46 0   | 72 12 0    | 1842   |                             |                  |              |
| Roberval.....                                      | 48 31 0   | 72 14 0    | 1906 7 |                             |                  | 19 44 5W     |
| Mistassini.....                                    | 48 54 0   | 72 14 0    | 1906 7 |                             |                  | 19 20 5 "    |
| Lake Memphremagog.....                             | 45 01 0   | 72 15 0    | 1845   |                             |                  |              |
| Lake Edward.....                                   | 47 40 0   | 72 15 0    | 1906 7 |                             |                  | 19 34 4W     |
| Three Rivers.....                                  | 46 21 0   | 72 32 0    | 1842   |                             |                  |              |
| " .....  | 46 21 0   | 72 33 0    | 1906 7 |                             |                  | 15 26 1W     |
| Farnham.....                                       | 45 16 1   | 73 01 5    | 1907   | Sept. 9,10,11               |                  | 15 12 4 "    |
| Sorel.....   | 46 02 0   | 73 03 0    | 1842   |                             |                  |              |
| " .....  | "         | "          | "      | "                           |                  |              |
| St. Johns.....                                     | 45 17 0   | 73 15 0    | 1842   |                             |                  |              |
| Montreal.....                                      | 45 31 0   | 73 30 0    | 1833   |                             |                  |              |
| St. Helens island, Montreal..                      | 45 31 1   | 73 31 7    | 1842   | Sept. 19 ..                 | 8 31a            | 8 57 6W      |
| " .....  | "         | "          | 1843   |                             |                  |              |
| " .....  | "         | "          | "      | "                           |                  |              |
| " .....  | "         | "          | "      | "                           |                  |              |
| Montreal, The Mountain.....                        | 45 31 0   | 73 33 3    | 1845   |                             |                  |              |
| Montreal.....                                      | 45 31 0   | 73 32 0    | 1843   |                             |                  |              |
| " .....  | 45 30 0   | 73 33 0    | 1838   |                             |                  |              |
| " .....  | 45 30 3   | 73 34 9    | 1859   | July 20 .....               |                  | 12 21 0W     |
| " .....  | "         | "          | 1879   | Sept. 25 .....              |                  | 13 40 5 "    |
| " .....  | "         | 73 35 0    | 1896 8 |                             |                  | 14 19 0 "    |
| " .....  | "         | "          | 1905 7 |                             |                  | 14 40 1 "    |
| " .....  | "         | "          | 1906 7 |                             |                  |              |





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TABLE  
MAGNETIC

QUEBEC—

C. I.—Carnegie Institution.  
C. S.—Coast Survey.

| Place.                       | Latitude. | Longitude. | Year.  | Month<br>and<br>day. | Hour<br>and<br>minute. | Declination. |
|------------------------------|-----------|------------|--------|----------------------|------------------------|--------------|
|                              | °   '   " | °   '   "  |        |                      |                        | °   '   "    |
| *Isle Dorval.....            | 45 25 0   | 73 44 0    | 1843   |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| St. Jérôme.....              | 45 46 0   | 73 59 0    | 1906 7 |                      |                        | 15 49 2W     |
| Lacombe farm.....            | 55 33 0   | 74 09 0    | 1843 3 |                      |                        | 8 26 0 "     |
| Labelle .....                | 46 16 0   | 74 33 0    | 1906 7 |                      |                        | 15 24 6 "    |
| *Pointe du Chêne.....        | 45 37 0   | 74 50 0    | 1843   | May 3                | 6 40p                  | 7 28 0 "     |
| " .....                      | "         | "          | "      |                      |                        |              |
| *Mishomis.....               | 47 13 0   | 75 38 0    | 1906 8 |                      |                        | 18 15 3W     |
| Baskatong .....              | 46 49 0   | 75 52 0    | 1906 8 |                      |                        | 12 16 2 "    |
| Aylmer .....                 | 45 15 0   | 75 58 0    | 1843   |                      |                        |              |
| Maniwaki.....                | 46 23 0   | 75 59 0    | 1906 7 |                      |                        | 12 20 0W     |
| *Portage des Chats.....      | 45 26 0   | 76 32 0    | 1843   |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| Portage du Grand Calumet.... | 45 45 0   | 76 40 0    | 1843   |                      |                        |              |
| Fort Coulonge.....           | 45 54 9   | 76 45 0    | 1843   |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| Pointe Baptême.....          | 46 05 0   | 77 26 0    | 1843   |                      |                        |              |
| Portage des Deux-Joachims... | 46 12 1   | 77 40 0    | 1843   |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| Trou portage.....            | 46 15 0   | 78 16 0    | 1843   |                      |                        |              |
| " .....                      | "         | "          | "      |                      |                        |              |
| Kipawa.....                  | 46 47 0   | 78 59 0    | 1906 8 |                      |                        | 9 44 9W      |

\* Local disturbance.

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IV—*Con.*

RESULTS—*Con.*

LABRADOR—*Con.*

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|---------------|
| April 30.      | p. m.            | 77 03.1 | April 30.      |                  |              | 6302          |              | J. H. Lefroy. |
|                |                  |         | " 30.          |                  |              | 6297          |              | "             |
|                |                  |         | " 30.          |                  |              | 6261          |              | "             |
|                |                  | 76 08.2 |                |                  |              | 1487          |              | C. I.         |
|                |                  | 76 50.6 |                |                  |              | 1454          |              | J. H. Lefroy. |
|                |                  | 76 29.8 |                |                  |              | 1432          |              | C. I.         |
| May 3.         |                  | 76 55.4 | May 3.         |                  |              | 6273          |              | J. H. Lefroy. |
|                |                  |         | " 3.           |                  |              | 6302          |              | "             |
|                |                  | 77 04.2 |                |                  |              | 1392          |              | C. I.         |
|                |                  | 76 38.5 |                |                  |              | 1417          |              | "             |
| May 5.         |                  | 76 41.0 | May 5.         |                  |              | 6380          |              | J. H. Lefroy. |
|                |                  | 76 29.5 |                |                  |              | 1441          |              | C. I.         |
| May 6.         | Noon.            | 75 07.0 | May 6.         |                  |              | 6450          |              | J. H. Lefroy. |
|                |                  |         | " 6.           |                  |              | 6399          |              | "             |
| May 7.         | p. m.            | 76 44.4 | " 7.           |                  |              | 6378          |              | "             |
| " 8.           | p. m.            | 77 29.7 | " 8.           |                  |              | 6418          |              | "             |
| " 8.           |                  | 77 16.7 | " 8.           |                  |              | 6415          |              | "             |
|                |                  |         | " 8.           |                  |              | 6433          |              | "             |
| May 9.         | 3 00p            | 77 19.1 | " 9.           |                  |              | 6351          |              | "             |
| " 10.          | 11 00a           | 77 03.8 | " 10.          |                  |              | 6374          |              | "             |
|                |                  |         | " 10.          |                  |              | 6383          |              | "             |
| May 11.        | p. m.            | 77 24.4 | " 11.          |                  |              | 6429          |              | "             |
|                |                  |         | " 11.          |                  |              | 6403          |              | "             |
|                |                  | 76 41.8 |                |                  |              | 1430          |              | C. I.         |

TABLE  
MAGNETIC

ONTA

C. I.—Carnegie Institution.  
L. S.—Lake Survey.  
C. S.—Coast Survey.

| Place.                             | Latitude. | Longitude. | Year.  | Month and day. | Hour and minute. | Declination. |
|------------------------------------|-----------|------------|--------|----------------|------------------|--------------|
| Hawkesbury . . . . .               | 45 36.0   | 74 37.0    | 1906 7 |                |                  | 11 51.3 W    |
| Cornwall . . . . .                 | 45 02.0   | 74 50.0    | 1845   |                |                  |              |
| Williamsburg . . . . .             | 44 55.0   | 75 07.0    | 1843   |                |                  |              |
| Fox Point, Ottawa river . . . . .  | 45 32.0   | 75 22.0    | 1843   |                |                  |              |
| Prescott . . . . .                 | 44 35.0   | 75 30.0    | 1843   |                |                  |              |
| Brockville . . . . .               | 44 35.9   | 75 40.7    | 1907   | Sept. 2, 3, 4. |                  | 10 34.2      |
| " . . . . .                        | 44 32.0   | 75 41.0    | 1845   |                |                  |              |
| Ottawa . . . . .                   | 45 21.0   | 75 42.0    | 1856   |                |                  |              |
| " . . . . .                        | 45 23.6   | 75 42.9    | 1907   | June 3.        |                  | 12 36.5      |
| " (C. I. S.). . . . .              | 45 24.0   | 75 43.0    | 1908   | Nov. 2, 5, 26  |                  | 12 48.5 W    |
| " (Magnetic hut). . . . .          |           |            | "      | " 20, 23, 26   |                  | 12 50.5 "    |
| Kingston Jet. . . . .              | 44 15.2   | 76 28.0    | 1907   | Aug. 27, 28    |                  | 14 16.9      |
| " (R. M. College*). . . . .        | 44 13.8   | 76 28.2    | "      | " 20, 21.      |                  | 36 46.4      |
| " (Artillery Barracks*). . . . .   | 44 13.0   | 76 28.6    | 1842   |                |                  |              |
| " . . . . .                        | "         | "          | 1843   |                |                  |              |
| " . . . . .                        | "         | "          | 1845   |                |                  |              |
| Kingston (Stewart point) . . . . . | 44 12.0   | 76 29.0    | "      |                |                  |              |
| Kingston (Barracks). . . . .       | 44 13.0   | 76 29.2    | 1907   | Aug. 25        |                  | *30 07.4     |
| Kingston Junction. . . . .         | 44 15.0   | 76 29.0    | 1906 7 |                |                  | 13 26.0 W    |
| Kingston (The Common) . . . . .    | 44 13.0   | 76 30.0    | 1845   |                |                  |              |
| Renfrew . . . . .                  | 45 29.0   | 76 40.0    | 1906 7 |                |                  | 11 13.6 W    |
| Sharbot lake. . . . .              | 44 46.4   | 76 41.2    | 1907   |                |                  | 11 28.7      |
| Pembroke . . . . .                 | 45 49.3   | 77 07.5    | "      |                |                  | 10 16.7      |
| Belleville . . . . .               | 44 09.0   | 77 25.0    | 1843   |                |                  |              |
| Chalk river. . . . .               | 46 00.0   | 77 26.0    | 1906 8 |                |                  | 10 20.2 W    |
| Barry bay. . . . .                 | 45 28.8   | 77 40.3    | 1907   | Aug. 9.        |                  | 08 46.3      |
| Madawaska . . . . .                | 45 30.0   | 77 59.0    | 1906 7 |                |                  | 9 05.2 "     |
| Cobourg . . . . .                  | 43 56.0   | 78 10.0    | 1843   |                |                  |              |
| Peterborough . . . . .             | 44 18.0   | 78 18.0    | 1906 7 |                |                  | 8 16.1 "     |
| Kimnount . . . . .                 | 44 48.0   | 78 39.0    | 1906 7 |                |                  | 8 22.7 "     |
| Mattawa . . . . .                  | 46 19.7   | 78 41.0    | 1907   | July 23, 24    |                  | 8 44.3       |
| Little river . . . . .             | 46 15.4   | 78 44.0    | 1843   |                |                  |              |
| " . . . . .                        | "         | "          | "      |                |                  |              |
| Joe lake . . . . .                 | 45 35.2   | 78 46.5    | 1907   | Aug. 6, 7.     |                  | 7 30.1       |
| Niagara village. . . . .           | 43 15.0   | 79 04.0    | 1843   |                |                  |              |
| Niagara Falls . . . . .            | 43 04.0   | 79 05.0    | 1841   |                |                  |              |
| " . . . . .                        | "         | "          | 1845   |                |                  |              |
| South side of Trout lake. . . . .  | 46 18.5   | 79 13.0    | 1843   |                |                  |              |
| " . . . . .                        | "         | "          | "      |                |                  |              |
| Agincourt (Mag. Obsy.). . . . .    | 43 47.0   | 79 16.0    | 1905   |                |                  | 5 40.3 "     |
| " . . . . .                        | "         | "          | 1906 8 |                |                  | 5 47.0 "     |
| " . . . . .                        | "         | "          | 1908   | July 9, 11.    |                  | 6 2.2 "      |
| " . . . . .                        | "         | "          | "      | " 9, 11.       |                  | 5 59.0 "     |
| Emsdale . . . . .                  | 45 32.0   | 79 18.0    | 1906 7 |                |                  | 7 52.2 "     |

\* Local disturbance.

SESSIONAL PAPER No. 25a

V.

RESULTS.

110.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.        |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|------------------|
|                |                  | 76 03 1 |                |                  | 1500         |               |             | C. I.            |
| June 16        |                  | 76 16 5 | June 16        |                  |              | 6355          |             | C. Younghusband. |
| " 16           |                  | 76 16 3 | " 16           |                  |              | 6361          |             | "                |
| April 20       |                  | 76 31 8 | April 20       |                  |              | 6425          |             | J. H. Lefroy.    |
| " 20           |                  | 76 29 8 | " 20           |                  |              | 6452          |             | "                |
| May 4          |                  | 76 35 3 | May 4          |                  |              | 6410          |             | "                |
|                |                  |         | " 4            |                  |              | 6370          |             | "                |
| April 19       |                  | 78 42 5 |                |                  |              |               |             | "                |
|                |                  | 75 03 6 |                |                  | 1577         | 6118          |             | White-Fraser.    |
| June 13        |                  | 76 19 8 | June 13        |                  |              | 6320          |             | C. Younghusband. |
| " 13           |                  | 76 18 0 | " 13           |                  |              | 6324          |             | "                |
| August         |                  | 76 42 9 |                |                  |              |               |             | K. Friesack.     |
|                |                  | 75 41 2 |                |                  | 1505         | 6086          |             | White-Fraser.    |
| Nov. 2         |                  | 75 41 9 |                |                  | 1516         |               |             | C. A. French.    |
|                |                  |         | Nov. 23, 27    |                  | 1516         |               |             | "                |
|                |                  | 74 57 8 |                |                  | 1613         | 6219          |             | White-Fraser.    |
|                |                  | 73 27 3 |                |                  | 1708         | 5998          |             | "                |
| Nov. 11        |                  | 77 18 8 | Nov. 11        |                  |              | 6816          |             | J. H. Lefroy.    |
| " 11           |                  | 77 19 1 | " 11           |                  |              | 6990          |             | "                |
| April 18       |                  | 77 18 1 | April 18       |                  |              | 6921          |             | "                |
|                |                  |         | " 18           |                  |              | 6967          |             | "                |
| June 10        |                  | 77 14 2 | June 10        |                  |              | 6965          |             | C. Younghusband. |
| " 10           |                  | 77 14 7 | " 10           |                  |              | 6969          |             | "                |
|                |                  |         | " 11           |                  |              | 6672          |             | "                |
|                |                  |         | " 11           |                  |              | 6652          |             | "                |
|                |                  | 74 37 3 |                |                  |              |               |             | White-Fraser.    |
|                |                  | 74 57 3 |                |                  | 1621         |               |             | C. I.            |
|                |                  |         | June 11        |                  |              | 7137          |             | C. Younghusband. |
|                |                  |         | " 11           |                  |              | 7125          |             | "                |
|                |                  | 75 46 7 |                |                  | 1513         |               |             | C. I.            |
|                |                  | 74 54 6 |                |                  | 1608         | 6173          |             | White-Fraser.    |
|                |                  | 76 11 2 |                |                  | 1476         | 6182          |             | "                |
| April 17       |                  | 77 01 0 |                |                  |              |               |             | J. H. Lefroy.    |
|                |                  | 76 23 5 |                |                  | 1461         |               |             | C. I.            |
|                |                  | 75 53 9 |                |                  | 1501         | 6197          |             | White-Fraser.    |
|                |                  | 75 54 0 |                |                  | 1503         |               |             | C. I.            |
| April 16       |                  | 75 27 2 |                |                  |              |               |             | Corporal Henry.  |
|                |                  | 74 42 9 |                |                  | 1647         |               |             | C. I.            |
|                |                  | 75 18 2 |                |                  | 1558         |               |             | C. I.            |
|                |                  | 76 41 2 |                |                  | 1429         | 6205          |             | White-Fraser.    |
| May 12         |                  | 77 28 5 | May 12         |                  |              | 6448          |             | J. H. Lefroy.    |
|                |                  |         | " 12           |                  |              | 6406          |             | "                |
|                |                  | 75 56 0 |                |                  | 1525         | 6281          |             | White-Fraser.    |
| Mar. 11        |                  | 74 45 6 | Mar. 11        |                  |              | 6387          |             | J. H. Lefroy.    |
| Sept.          |                  | 74 54 7 |                |                  |              |               |             | J. M. Nicolle.   |
| Oct. 18        |                  | 74 46 8 | Oct. 18        |                  |              | 6342          |             | J. H. Lefroy.    |
|                |                  |         | " 18           |                  |              | 6345          |             | "                |
| May 13         |                  | 77 21 7 | May 13         |                  |              | 6430          |             | "                |
|                |                  |         | " 13           |                  |              | 6437          |             | "                |
|                |                  | 74 33 8 |                |                  | 1643         |               |             | Observatory.     |
|                |                  | 74 35 6 |                |                  | 1638         |               |             | C. I.            |
| July 9         |                  | 74 32 1 | July 10, 11    |                  |              | 1638          |             | C. A. French.    |
|                |                  |         | " 10, 11       |                  |              | 1637          |             | Observatory.     |
|                |                  | 75 48 7 |                |                  | 1520         |               |             | C. I.            |

TABLE  
MAGNETIC

ONTA

| Place.                        | Latitude. | Longitude. | Year. | Month and day. | Hour and minute. | Declination. |
|-------------------------------|-----------|------------|-------|----------------|------------------|--------------|
| Toronto, Magnetic Observatory | 43 39.4   | 79 23.3    | 1841  | 12 months      |                  | 1 14.3W      |
| "                             | "         | "          | 1842  | "              |                  | 1 19.1 "     |
| "                             | "         | "          | 1843  | "              |                  | "            |
| "                             | "         | "          | 1844  | "              |                  | "            |
| "                             | "         | "          | 1845  | 12 months      |                  | 1 29.1 "     |
| "                             | "         | "          | 1846  | "              |                  | 1 30.8 "     |
| "                             | "         | "          | 1847  | "              |                  | 1 33.2 "     |
| "                             | "         | "          | 1848  | "              |                  | 1 35.4 "     |
| "                             | "         | "          | 1849  | "              |                  | 1 36.9 "     |
| "                             | "         | "          | 1850  | "              |                  | 1 38.6 "     |
| "                             | "         | "          | 1851  | "              |                  | 1 40.9 "     |
| "                             | "         | "          | 1852  | "              |                  | "            |
| "                             | "         | "          | 1853  | July & Aug.    | Cor. for year.   | 1 46.1 "     |
| "                             | "         | "          | 1854  | Feb. to June   |                  | 1 48.0 "     |
| "                             | "         | "          | 1855  | Aug. to Dec.   |                  | 1 52.3 "     |
| "                             | "         | "          | 1856  | 12 months      |                  | 1 56.3 "     |
| "                             | "         | "          | 1857  | "              |                  | 2 00.5 "     |
| "                             | "         | "          | 1858  | "              |                  | 2 04.5 "     |
| "                             | "         | "          | 1859  | "              |                  | 2 07.4 "     |
| "                             | "         | "          | 1860  | "              |                  | 2 10.6 "     |
| "                             | "         | "          | 1861  | "              |                  | 2 14.4 "     |
| "                             | "         | "          | 1862  | "              |                  | 2 15.7 "     |
| "                             | "         | "          | 1863  | "              |                  | 2 19.1 "     |
| "                             | "         | "          | 1864  | "              |                  | 2 21.9 "     |
| "                             | "         | "          | 1865  | "              |                  | 2 24.8 "     |
| "                             | "         | "          | 1866  | "              |                  | 2 27.6 "     |
| "                             | "         | "          | 1867  | "              |                  | 2 29.8 "     |
| "                             | "         | "          | 1868  | "              |                  | 2 33.2 "     |
| "                             | "         | "          | 1869  | "              |                  | 2 37.1 "     |
| "                             | "         | "          | 1870  | "              |                  | 2 41.9 "     |
| "                             | "         | "          | 1871  | "              |                  | 2 47.9 "     |
| "                             | "         | "          | 1872  | "              |                  | 2 53.3 "     |
| "                             | "         | "          | 1873  | "              |                  | 2 56.9 "     |
| "                             | "         | "          | 1874  | "              |                  | 3 01.5 "     |
| "                             | "         | "          | 1875  | "              |                  | 3 06.4 "     |
| "                             | "         | "          | 1876  | "              |                  | 3 12.5 "     |
| "                             | "         | "          | 1877  | "              |                  | 3 22.6 "     |
| "                             | "         | "          | 1878  | "              |                  | 3 31.3 "     |
| "                             | "         | "          | 1879  | "              |                  | 3 36.0 "     |
| "                             | "         | "          | 1880  | "              |                  | 3 40.0 "     |
| "                             | "         | "          | 1881  | "              |                  | 3 46.6 "     |
| "                             | "         | "          | 1882  | "              |                  | 3 50.5 "     |
| "                             | "         | "          | 1883  | "              |                  | 3 54.3 "     |
| "                             | "         | "          | 1884  | "              |                  | 3 57.7 "     |
| "                             | "         | "          | 1885  | "              |                  | 3 59.8 "     |
| "                             | "         | "          | 1886  | "              |                  | 4 02.1 "     |
| "                             | "         | "          | 1887  | "              |                  | 4 04.8 "     |
| "                             | "         | "          | 1888  | "              |                  | 4 08.3 "     |
| "                             | "         | "          | 1889  | "              |                  | 4 12.0 "     |
| "                             | "         | "          | 1890  | "              |                  | 4 18.2 "     |
| "                             | "         | "          | 1891  | "              |                  | 4 23.3 "     |
| "                             | "         | "          | 1892  | "              |                  | 4 29.2 "     |
| "                             | "         | "          | 1893  | "              |                  | 4 36.4 "     |
| "                             | "         | "          | 1894  | "              |                  | 4 42.2 "     |
| "                             | "         | "          | 1895  | "              |                  | 4 44.7 "     |
| "                             | "         | "          | 1896  | "              |                  | 4 48.9 "     |
| "                             | "         | "          | 1897  | "              |                  | 4 52.8 "     |
| "                             | "         | "          | 1898  | *6 "           |                  | 4 55.0 "     |

\* Observatory moved to Agincourt in September 1898. The mean is interpolated from 6 months.  
 \*\* For January-July, October-December; 9 months.

SESSIONAL PAPER No. 25a

V—*Con.*

RESULTS—*Con.*

RIO—*Con.*

| Month and day. | Hour and minute. | Dip. | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer. |
|----------------|------------------|------|----------------|------------------|--------------|---------------|--------------|-----------|
| 12 months.     |                  | 73   | 16 6           |                  |              |               |              |           |
| "              |                  |      | 16 4           |                  |              |               |              |           |
| "              |                  |      | 14 7           |                  |              |               |              |           |
| "              |                  |      | 14 8           |                  |              |               |              |           |
| "              |                  |      | 15 5           | 12 months.       |              | 64284         |              |           |
| "              |                  |      | 15 1           | "                |              | 64153         |              |           |
| "              |                  |      | 15 3           | "                |              | 64094         |              |           |
| "              |                  |      | 18 3           | "                |              | 64234         |              |           |
| "              |                  |      | 18 8           | "                |              | 64331         |              |           |
| "              |                  |      | 20 0           | "                |              | 64323         |              |           |
| "              |                  |      | 20 4           | "                |              | 64311         |              |           |
| "              |                  |      | 20 5           | "                |              | 64054         |              |           |
| 10 months      |                  |      | 22 2           |                  |              |               |              |           |
| 12             |                  |      | 23 0           |                  |              |               |              |           |
| "              |                  |      | 23 5           | Sept. to Dec.    |              | 64276         |              |           |
| "              |                  |      | 24 1           | 12 months.       |              | 64115         |              |           |
| "              |                  |      | 24 3           | "                |              | 63830         |              |           |
| "              |                  |      | 24 4           | "                |              | 63871         |              |           |
| "              |                  |      | 25 0           | "                |              | 63745         |              |           |
| "              |                  |      | 24 6           | "                |              | 63680         |              |           |
| "              |                  |      | 23 8           | "                |              | 63709         |              |           |
| "              |                  |      | 23 2           | "                |              | 63695         |              |           |
| "              |                  |      | 21 5           | "                |              | 63642         |              |           |
| "              |                  |      | 20 9           | "                |              | 63680         |              |           |
| "              |                  |      | 21 0           | "                |              | 63675         |              |           |
| "              |                  |      | 19 2           | "                |              | 63550         |              |           |
| "              |                  |      | 18 8           | "                |              | 63610         |              |           |
| "              |                  |      | 20 1           | "                |              | 63706         |              |           |
| "              |                  |      | 16 7           | "                |              | 63625         |              |           |
| "              |                  |      | 16 3           | "                |              | 63451         |              |           |
| "              |                  |      | 16 8           | "                |              | 63520         |              |           |
| "              |                  |      | 15 5           |                  |              |               |              |           |
| "              |                  |      | 16 2           |                  |              |               |              |           |
| "              |                  |      | 13 9           |                  |              |               |              |           |
| "              |                  |      | 14 0           |                  |              |               |              |           |
| "              |                  |      | 13 3           |                  |              |               |              |           |
| "              |                  |      | 6 6            |                  |              |               |              |           |
| "              |                  |      | 2 4            |                  |              |               |              |           |
| "              |                  |      | 0 5            |                  |              |               |              |           |
| "              |                  | 74   | 57 3           |                  |              |               |              |           |
| "              |                  |      | 59 2           |                  |              |               |              |           |
| "              |                  |      | 55 2           |                  |              |               |              |           |
| "              |                  |      | 54 1           |                  |              |               |              |           |
| "              |                  |      | 53 2           |                  |              |               |              |           |
| "              |                  |      | 51 6           |                  |              |               |              |           |
| "              |                  |      | 49 0           |                  |              |               |              |           |
| "              |                  |      | 48 0           |                  |              |               |              |           |
| "              |                  |      | 46 5           |                  |              |               |              |           |
| "              |                  |      | 44 7           |                  |              |               |              |           |
| "              |                  |      | 42 2           |                  |              |               |              |           |
| "              |                  |      | 37 5           |                  |              |               |              |           |
| "              |                  |      | 37 0           |                  |              |               |              |           |
| "              |                  |      | 35 7           |                  |              |               |              |           |
| "              |                  |      | 34 2           |                  |              |               |              |           |
| "              |                  |      | 34 2           |                  |              |               |              |           |
| "              |                  |      | 34 7           |                  |              |               |              |           |
| "              |                  |      | 36 1           |                  |              |               |              |           |
| **9            |                  |      | 37 0           |                  |              |               |              |           |

observations for the year.

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

ONTA

C. I.—Carnegie Institution.  
L. S.—Lake Survey.  
C. S.—Coast Survey.

| Place.                            | Latitude. | Longitude. | Year. | Month and day.           | Hour and minute. | Declination. |
|-----------------------------------|-----------|------------|-------|--------------------------|------------------|--------------|
| Toronto, Agincourt...             | 43 47     | 79 16      | 1899  | 12 months                |                  | 5 26.5 W.    |
| " " "                             | " "       | " "        | 1900  | "                        |                  | 5 27.8 "     |
| " " "                             | " "       | " "        | 1901  | "                        |                  | 5 29.4 "     |
| " " "                             | " "       | " "        | 1902  | "                        |                  | 5 31.7 "     |
| " " "                             | " "       | " "        | 1903  | "                        |                  | 5 33.7 "     |
| " " "                             | " "       | " "        | 1904  | 10 "                     |                  | 5 36.4 "     |
| " " "                             | " "       | " "        | 1905  | 12 "                     |                  | 5 42.2 "     |
| " " "                             | " "       | " "        | 1906  | "                        |                  | 5 45.6 "     |
| " " "                             | " "       | " "        | 1907  | "                        |                  | 5 50.6 "     |
| North Bay...                      | 46 18.3   | 79 24.7    | 1907  | July, 18, 19, 20         |                  | 08 55.6 "    |
| " " "                             | 46 19.0   | 79 26.0    | 1906  | 8                        |                  | 8 44.2 "     |
| Barrie...                         | 44 21.0   | 79 41.0    | 1843  |                          |                  |              |
| New Liskeard...                   | 47 31.0   | 79 42.0    | 1906  | 8                        |                  | 8 50.0 "     |
| Timagami sta.                     | 47 04.0   | 79 47.0    | 1906  | 8                        |                  | 11 54.4 "    |
| Lake Nipissing                    | 46 11.0   | 79 48.0    | 1843  |                          |                  |              |
| Hamilton, in yard of Farmers inn. | 43 16.0   | 79 50.0    | 1842  |                          |                  |              |
| " " "                             | " "       | " "        | 1845  |                          |                  |              |
| Englehart.                        | 47 50.0   | 79 52.0    | 1906  | 8                        |                  | 9 05.8 "     |
| Penetanguishene.                  | 44 47.0   | 79 55.0    | 1906  | 7                        |                  | 6 58.9 "     |
| " " "                             | " "       | 79 58.0    | 1843  |                          |                  |              |
| " " "                             | " "       | " "        | 1825  |                          |                  |              |
| " " "                             | " "       | " "        | 1844  |                          |                  |              |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| Timagami inn.                     | 46 58.0   | 80 02.0    | 1906  | 8                        |                  | 11 26.8 "    |
| Rose point                        | 45 19.1   | 80 02.3    | 1907  | July 31, Aug. 1, 2, 3, 4 |                  |              |
| Twin lake.                        | 48 16.0   | 80 17.0    | 1906  | 8                        |                  | 6 49.1 "     |
| Simcoe.                           | 42 51.0   | 80 18.0    | 1906  | 8                        |                  | 7 47.5 "     |
| Ricoulet falls.                   | 45 57.0   | 80 30.0    | 1843  |                          |                  | 4 39.7 "     |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| Berlin.                           | 43 27.0   | 80 31.0    | 1906  | 8                        |                  | 5 27.9 "     |
| Owen Sound.                       | 44 35.0   | 80 57.0    | 1906  | 7                        |                  | 5 45.8 "     |
| Sudbury.                          | 46 30.0   | 81 00.0    | 1906  | 7                        |                  | 6 26.8 "     |
| " " "                             | 46 29.0   | 81 00.0    | 1907  | July 15, 16, 17          |                  | 6 54.9 "     |
| Small island, Lake Huron          | 45 55.5   | 81 02.0    | 1843  |                          |                  |              |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| Hyde Park Je                      | 42 59.0   | 81 19.0    | 1906  | 8                        |                  | 3 26.8 "     |
| Stokes bay.                       | 44 59.0   | 81 22.0    | 1905  | 8                        |                  | 6 14.8 "     |
| Southampton.                      | 44 39.0   | 81 23.0    | 1905  | 8                        |                  | 6 04.5 "     |
| Kincardine.                       | 44 11.0   | 81 38.0    | 1905  | 8                        |                  | 5 12.4 "     |
| Frazer bay, Lake Huron.           | 46 00.0   | 81 40.0    | 1843  |                          |                  |              |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| Goderich, in garden foot of hill  | 43 45.0   | 81 41.0    | 1845  |                          |                  |              |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| " " "                             | " "       | " "        | "     |                          |                  |              |
| " " "                             | 43 46.0   | 81 42.0    | 1906  | 7                        |                  | 4 15.5 "     |
| " 1/4 mile S. of Town Hall        | 43 44.0   | 81 43.0    | 1860  |                          |                  |              |
| Cove island                       | 45 20.0   | 81 43.0    | 1860  | 7                        |                  | 3 58.6 "     |
| " " "                             | " "       | 81 44.0    | 1905  | 7                        |                  | 7 02.4 "     |
| Goderich.                         | 43 44.0   | 81 44.0    | 1905  | 8                        |                  | 4 20.7 "     |
| Cape Ipperwash, Lake Huron.       | 43 13.0   | 82 00.0    | 1860  |                          |                  |              |
| Kettle point.                     | 43 13.0   | 82 01.0    | 1905  | 8                        |                  | 3 43.6 "     |
| Fort La Cloche, Lake Huron.       | 46 07.0   | 82 03.0    | 1843  | May 18                   | 8 33a            | 2 10.0 "     |
| " " "                             | " "       | " "        | 1844  |                          |                  |              |

\* Local disturbance.



SESSIONAL PAPER No. 25a

V—Con.

RESULTS—Con.

XI0—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
| 12 months.     |                  | 74 35.9 |                |                  |              |               |             |               |
| "              |                  | 32.5    |                |                  |              |               |             |               |
| "              |                  | 32.1    |                |                  |              |               |             |               |
| "              |                  | 32.0    |                |                  |              |               |             |               |
| "              |                  | 32.6    |                |                  |              |               |             |               |
| "              |                  | 33.2    |                |                  |              |               |             |               |
|                |                  |         |                |                  |              |               |             |               |
|                |                  | 76 35.7 |                |                  | 1433         | 6182          |             | White-Fraser. |
|                |                  | 76 37.4 |                |                  | 1442         |               |             | C. I.         |
| Jan. 24.       |                  | 75 49.9 |                |                  |              |               |             | J. H. Lefroy. |
|                |                  | 77 34.7 |                |                  | 1348         |               |             | C. I.         |
|                |                  | 76 05.9 |                |                  | 1521         |               |             | C. I.         |
| May 14.        | p.m.             | 77 09.5 | May 14.        |                  |              | 6391          |             | J. H. Lefroy. |
| Dec. 29.       |                  | 74 56.7 | Dec. 29        |                  |              | 6374          |             | "             |
| " 31.          |                  | 74 54.1 |                |                  |              |               |             | J. H. Lefroy. |
|                |                  | 77 49.6 |                |                  | 1320         |               |             | C. I.         |
|                |                  | 75 27.9 |                |                  | 1556         |               |             | C. I.         |
| Jan. 26.       |                  | 76 04.2 |                |                  |              |               |             | J. H. Lefroy. |
| April 18.      |                  | 76 16.0 |                |                  |              |               |             | Franklin.     |
| Nov. 11.       |                  | 76 19.2 | Nov. 11.       |                  |              | 6491          |             | J. H. Lefroy. |
| " 11.          |                  | 76 21.0 | " 15.          |                  |              | 6483          |             | "             |
|                |                  |         | " 15.          |                  |              | 6483          |             | "             |
|                |                  |         | " 15.          |                  |              | 6506          |             | "             |
|                |                  | 76 47.4 |                |                  | 1428         |               |             | C. I.         |
|                |                  | 75 36.1 |                |                  | 1525         | 6588          |             | White-Fraser. |
|                |                  | 77 39.4 |                |                  | 1365         |               |             | C. I.         |
|                |                  | 74 04.6 |                |                  | 1701         |               |             | C. I.         |
| May 15.        | 2 00p            | 76 45.4 | May 15         |                  |              | 6531          |             | J. H. Lefroy. |
|                |                  |         | " 15.          |                  |              | 6406          |             | "             |
|                |                  | 74 23.3 |                |                  | 1666         |               |             | C. I.         |
|                |                  | 75 10.7 |                |                  | 1590         |               |             | C. I.         |
|                |                  | 76 22.0 |                |                  | 1477         | 6254          |             | C. I.         |
|                |                  | 76 35.2 |                |                  | 1451         |               |             | White-Fraser. |
| May 16.        |                  | 76 31.3 | May 16         |                  |              | 6422          |             | J. H. Lefroy. |
|                |                  |         | " 16.          |                  |              | 6394          |             | "             |
|                |                  |         | " 16.          |                  |              | 6448          |             | "             |
|                |                  | 73 56.6 |                |                  | 1704         |               |             | C. I.         |
|                |                  | 75 32.0 |                |                  | 1538         |               |             | L. S.         |
|                |                  | 75 00.0 |                |                  | 1584         |               |             | L. S.         |
|                |                  | 74 36.0 |                |                  | 1641         |               |             | L. S.         |
| May 17.        | 2 00p            | 77 05.6 | May 17.        | 2 00p            |              | 6412          |             | J. H. Lefroy. |
|                |                  |         | " 17.          |                  |              | 6411          |             | "             |
| Oct. 28.       |                  | 75 04.4 | Oct. 28.       |                  |              | 6380          |             | "             |
|                |                  |         | " 28.          |                  |              | 6374          |             | "             |
| Oct. 28.       |                  | 75 05.3 | " 28.          |                  |              | 6376          |             | "             |
|                |                  |         | " 28.          |                  |              | 6383          |             | "             |
|                |                  | 74 26.5 |                |                  | 1660         |               |             | C. I.         |
| July 19.       |                  | 75 02.0 |                |                  |              | 6383          |             | W. P. Smith   |
|                |                  | 76 32.0 |                |                  | 1506         |               |             | L. S.         |
|                |                  | 75 44.0 |                |                  | 1553         |               |             | L. S.         |
|                |                  | 74 29.0 |                |                  | 1645         |               |             | L. S.         |
| May 8.         |                  | 74 46.0 | May 28         |                  |              | 6427          |             | W. P. Smith.  |
|                |                  | 74 03.0 |                |                  | 1686         |               |             | L. S.         |
| Nov. 8.        |                  | 76 50.2 |                |                  |              |               |             | J. H. Lefroy. |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

ONTA

C. I.—Carnegie Institution.  
L. S.—Lake Survey.  
C. S.—Coast "

| Place.                           | Latitude. | Longitude. | Year.  | Month and day.  | Hour and minute. | Declination. |
|----------------------------------|-----------|------------|--------|-----------------|------------------|--------------|
| Biscotasing                      | 47 18 0   | 82 08 0    | 1906 7 |                 |                  | 3 07 2 "     |
| Chatham.                         | 42 24 0   | 82 10 0    | 1906 8 |                 |                  | 2 13 8 "     |
| Providence bay.                  | 45 40 0   | 82 17 0    | 1905 7 |                 |                  | 4 26 4 "     |
| Sarnia, garden near the ferry.   | 45 58 0   | 82 22 0    | 1845   |                 |                  |              |
| " " "                            | 45 58 0   | 82 22 0    | 1845   |                 |                  |              |
| Snake island, Lake Huron         | 46 10 0   | 82 40 0    | 1843   |                 |                  |              |
| " " "                            | 46 11 0   | 82 50 0    | 1906 8 |                 |                  | 4 35 4 W.    |
| Great Duck island                | 45 38 0   | 82 56 0    | 1905 7 |                 |                  | 2 22 8       |
| Amherstburg.                     | 42 06 0   | 83 03 0    | 1845   |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| Missisagi straits.               | 45 54 0   | 83 14 0    | 1905 7 |                 |                  | 4 06 4 "     |
| *Cockburn island                 | 45 52 0   | 83 21 0    | 1905 7 |                 |                  | 2 11 3 E.    |
| Chapleau.                        | 47 50 0   | 83 27 0    | 1906 8 |                 |                  | 4 04 0 W.    |
| " " "                            | 47 49 6   | 83 27 0    | 1907   | July 11, 12, 13 |                  | 3 47 0       |
| Thessalon point, Lake Huron      | 46 17 0   | 83 33 0    | 1843   | May 19.         | 3-26p            | 0 11 4 "     |
| " " "                            | "         | "          |        |                 |                  |              |
| Missinaibi.                      | 48 20 0   | 84 07 0    | 1906 7 |                 |                  | 5 39 1 "     |
| Sault Ste. Marie.                | 46 30 9   | 84 21 5    | 1844   | Nov. 4.         | 9-56a            | 1 14 1 E.    |
| " " "                            | "         | "          |        | " 4.            | 10-05a           | 0 51 1 "     |
| " " "                            | "         | "          |        | " 4.            | 11-05a           | 1 08 2 "     |
| Pointe aux Pins, Lake Superior   | 46 29 9   | 84 29 0    | 1845   |                 |                  |              |
| " " "                            | "         | "          | 1843   |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| Sinclair harbour.                | 47 22 0   | 84 42 0    | 1906 6 |                 |                  | 2 41 4 W.    |
| Parisian island                  | 46 39 0   | 84 42 0    | 1906 6 |                 |                  | 2 37 6 "     |
| Gros Cap.                        | 46 32 0   | 84 43 0    | 1841   |                 |                  |              |
| Pointe aux Crêpes, Lake Superior | 46 58 0   | 84 44 0    | 1843   | May 21.         | 5-08p            | 3 02 8 E.    |
| Mamainse point                   | 47 02 0   | 84 47 0    | 1906 6 |                 |                  | 0 34 7 "     |
| Michipicoten, Lake Superior      | 47 56 0   | 84 50 6    | 1880   | July 21, Sep. 9 |                  | 1 20 5 W.    |
| " " "                            | 47 56 2   | 84 54 0    | 1843   | May 23.         | 9-55a            | 0 20 3 E.    |
| " " "                            | "         | "          | 1844   |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| " " "                            | "         | "          | 1845   |                 |                  |              |
| Gargantua I.                     | 47 34 0   | 84 58 0    | 1906 7 |                 |                  | 2 26 3 W.    |
| *Cape Gargantua, L. Superior     | 47 36 9   | 85 05 0    | 1843   | May 21.         | 2-15p            | 0 38 0 E.    |
| " " "                            | "         | "          |        |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| White river.                     | 48 36 0   | 85 18 0    | 1906 7 |                 |                  | 3 00 6 W.    |
| Michipicoten I.                  | 47 42 0   | 85 46 0    | 1906 7 |                 |                  | 1 49 2 E.    |
| Caribou I. No 1.                 | 47 20 0   | 85 50 0    | 1906 7 |                 |                  | 1 16 6 W.    |
| Otter island                     | 48 06 0   | 86 03 0    | 1906 7 |                 |                  | 4 07 3 "     |
| *S.E. of Otter I., Lake Superior | 48 07 0   | 86 07 0    | 1843   |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| Tip-Top.                         | 48 15 0   | 86 08 0    | 1871   |                 |                  |              |
| Oiseaux bay.                     | 48 22 0   | 86 10 0    | 1906 7 |                 |                  | 1 41 4 "     |
| Rivière Blanche, Lake Superior   | 48 31 7   | 86 14 0    | 1844   | Oct. 21.        | 3-51p            | 2 15 2 E.    |
| " " "                            | "         | "          |        |                 |                  |              |
| " " "                            | "         | "          |        |                 |                  |              |
| Pic, Lake Superior.              | 48 35 3   | 86 15 0    | 1843   |                 |                  |              |
| " " "                            | "         | "          | 1844   | Oct. 18.        | 10-38a           | 5 13 3 E.    |
| " " "                            | "         | "          | "      | 18.             | 11-06a           | 5 52 5 "     |

\* Local disturbance.

SESSIONAL PAPER No. 25a

V—Con.

RESULTS—Con.

110—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.        |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|------------------|
|                |                  | 77 09.4 |                |                  |              | 1384          |             | C. I.            |
|                |                  | 73 33.4 |                |                  |              | 1749          |             | C. I.            |
|                |                  | 76 00.0 |                |                  |              | 1513          |             | L. S.            |
| Oct. 25.       |                  | 74 18.6 |                |                  |              | 6366          |             | J. H. Lefroy.    |
|                |                  |         |                |                  |              | 6370          |             | "                |
| Oct. 27.       |                  | 74 12.9 |                |                  |              | 6370          |             | "                |
|                |                  |         |                |                  |              | 6362          |             | "                |
| May 18.        |                  | 77 05.5 | May 18.        |                  |              | 6383          |             | "                |
|                |                  |         | " 18.          |                  |              | 6393          |             | "                |
|                |                  | 76 24.0 |                |                  |              | 1467          |             | C. I.            |
|                |                  | 76 24.0 |                |                  |              | 1461          |             | L. S.            |
| Oct. 22.       |                  | 73 32.7 | Oct. 22.       |                  |              | 6347          |             | J. H. Lefroy.    |
| " 22.          |                  | 73 27.2 | " 22.          |                  |              | 6342          |             | "                |
|                |                  | 76 40.0 |                |                  |              | 1421          |             | L. S.            |
|                |                  | 77 00.0 |                |                  |              | 1421          |             | L. S.            |
|                |                  | 77 50.6 |                |                  |              | 1329          |             | C. I.            |
|                |                  | 77 54.1 |                |                  |              | 1321          | 6304        | White-Fraser.    |
| May 19.        |                  | 76 59.3 | May 19.        |                  |              | 6484          |             | J. H. Lefroy.    |
| " 19.          |                  | 77 04.8 | " 19.          |                  |              | 6418          |             | "                |
|                |                  | 77 51.6 |                |                  |              | 1330          |             | C. I.            |
| Nov. 4.        |                  | 77 46.2 | Nov. 4.        |                  |              | 6365          |             | J. H. Lefroy.    |
| " 4.           |                  | 77 45.6 | " 4.           |                  |              | 6369          |             | "                |
|                |                  |         | " 4.           |                  |              | 6386          |             | "                |
| May.           |                  | 77 19.5 |                |                  |              |               |             | Dr. J. Rae.      |
| " 20.          |                  | 77 13.4 | May 20.        |                  |              | 6510          |             | J. H. Lefroy.    |
| " 20.          |                  | 77 12.1 | " 20.          |                  |              | 6462          |             | "                |
|                |                  |         | " 20.          |                  |              | 6481          |             | "                |
|                |                  | 77 26.0 |                |                  |              | 1411          |             | L. S.            |
|                |                  | 76 44.0 |                |                  |              | 1478          |             | L. S.            |
| Aug.           |                  | 77 05.3 |                |                  |              |               |             | E. Loomis.       |
| May 21.        |                  | 77 11.5 | May 21.        |                  |              | 6436          |             | J. H. Lefroy.    |
|                |                  | 77 18.0 |                |                  |              | 1444          |             | L. S.            |
|                |                  |         |                |                  |              |               |             | S. W. Very.      |
| May 23.        |                  | 78 06.3 | May 23.        |                  |              | 6460          |             | J. H. Lefroy.    |
| " 23.          |                  | 78 04.4 | " 23.          |                  |              | 6496          |             | "                |
| Oct. 30.       |                  | 78 08.1 | Oct. 30.       |                  |              | 6435          |             | "                |
| " 30.          |                  | 78 08.5 | " 30.          |                  |              | 6462          |             | "                |
|                |                  |         | " 30.          |                  |              | 6417          |             | "                |
|                |                  | 75 05.2 |                |                  |              |               |             | Dr. J. Rae.      |
|                |                  | 77 54.0 |                |                  |              | 1374          |             | L. S.            |
| May 21.        |                  | 77 56.1 | May 21.        |                  |              | 7019          |             | J. H. Lefroy.    |
|                |                  |         | " 21.          |                  |              | 7050          |             | "                |
|                |                  |         | " 21.          |                  |              | 7042          |             | "                |
|                |                  | 78 15.9 |                |                  |              | 1291          |             | C. I.            |
|                |                  | 77 36.0 |                |                  |              | 1379          |             | L. S.            |
|                |                  | 77 02.0 |                |                  |              | 1451          |             | L. S.            |
|                |                  | 78 42.0 |                |                  |              | 1253          |             | L. S.            |
| May 24.        | 1-30p            | 79 43.6 | May 24.        |                  |              | 6226          |             | J. H. Lefroy.    |
| " 24.          |                  | 79 32.8 | " 24.          |                  |              | 6330          |             | "                |
| Aug. 26.       |                  | 78 56.0 | Aug. 26.       |                  |              | 6358          |             | C. B. Coomstock. |
|                |                  | 78 04.0 |                |                  |              | 1319          |             | L. S.            |
| Oct. 21.       | 2-00p            | 78 33.7 | Oct. 21.       |                  |              | 6509          |             | J. H. Lefroy.    |
| " 21.          |                  | 78 32.5 | " 21.          |                  |              | 6524          |             | "                |
|                |                  |         | " 21.          |                  |              | 6494          |             | "                |
| May 25.        | a.m.             | 78 45.8 | May 25.        |                  |              | 6412          |             | "                |
| " 25.          | a.m.             | 78 40.8 | " 25.          |                  |              | 6460          |             | "                |
| Oct. 17.       | a.m.             | 78 32.8 | Oct. 17.       |                  |              | 6359          |             | "                |
| " 17.          | a.m.             | 78 29.9 | " 17.          |                  |              | 6387          |             | "                |
|                |                  |         | " 17.          |                  |              | 6349          |             | "                |

9-10 EDWARD VII., A. 1910

TABLE

MAGNETIC

ONTA

C. I.—Carnegie Institution.  
L. S.—Lake Survey.  
C. S.—Coast "

| Place.                             | Latitude. | Longitude. | Year.  | Month and day. | Hour and minute. | Declination. |
|------------------------------------|-----------|------------|--------|----------------|------------------|--------------|
| Pic, Lake Superior .....           | 48 35.3   | 86 15.0    | 1845   |                |                  |              |
| Peninsula harbor .....             | 48 42.0   | 86 20.0    | 1906.7 |                |                  | 4 53.7W      |
| " .....                            | 48 44.0   | 86 28.0    | 1824   |                |                  |              |
| *Black Rock.....                   | 48 41.0   | 86 30.0    | 1906.7 |                |                  | 19 26.4W     |
| Pic island.....                    | 48 42.0   | 86 34.0    | 1906.7 |                |                  | 2 45.8 "     |
| Sunday harbor.....                 | 48 37.0   | 86 59.0    | 1906.7 |                |                  | 1 21.0 "     |
| Schreiber .....                    | 48 49.0   | 87 18.0    | 1906.7 |                |                  | 0 22.4 "     |
| *Battle island, Lake Superior..... | 48 45.0   | 87 33.0    | 1843   |                |                  |              |
| " .....                            | 48 45.0   | 87 33.0    | 1843   |                |                  |              |
| " .....                            | 48 45.0   | 87 33.0    | 1843   |                |                  |              |
| " .....                            | 48 45.0   | 87 33.0    | 1906.7 |                |                  | 1 57.6W      |
| Simpson island, L. Superior.....   | 48 49.0   | 87 45.0    | 1843   | May 27         | 6-30a            | 5 44.8 E     |
| " .....                            | 48 49.0   | 87 45.0    | 1843   |                |                  |              |
| Isle St. Ignace .....              | 48 46.0   | 87 48.0    | 1906.7 |                |                  | 4 58.1 "     |
| Spar Point island .....            | 48 38.0   | 88 06.0    | 1906.7 |                |                  | 2 00.2 "     |
| Lamb island .....                  | 48 36.0   | 88 08.0    | 1906.7 |                |                  | 6 12.0 "     |
| *Porcupine island .....            | 48 38.0   | 88 09.0    | 1906.7 |                |                  | 21 30.1W     |
| Nipigon .....                      | 49 01.0   | 88 16.0    | 1906.7 |                |                  | 1 17.5 E     |
| Roche de Bout ids.....             | 48 31.0   | 88 21.0    | 1906.7 |                |                  | 0 29.4W      |
| Big Edward island.....             | 48 22.0   | 88 38.0    | 1906.8 |                |                  | 3 28.4 E     |
| Porphyry point .....               | 48 21.0   | 88 38.0    | 1906.8 |                |                  | 3 16.2 "     |
| Five miles east of Thunder cape    | 48 20.0   | 88 52.0    | 1843   |                |                  |              |
| " .....                            | 48 20.0   | 88 52.0    | 1843   |                |                  |              |
| Thunder harbor.....                | 48 19.0   | 88 53.0    | 1906.8 |                |                  | 2 14.0 E     |
| Port Arthur.....                   | 48 26.0   | 89 12.6    | 1884   |                |                  |              |
| Fort William .....                 | 48 23.5   | 89 13.5    | 1843   | May 29         | 5-32p            | 6 14.3 E     |
| " .....                            | 48 23.5   | 89 13.5    | 1843   | " 30           | 4-12p            | 6 41.9 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1843   | " 30           | 4-17p            | 6 56.6 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1843   | " 31           | 9-11a            | 6 46.1 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1824   |                |                  | 9 05.0 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1825   | May 12         |                  | 7 17.5 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1844   | Oct. 11        |                  | 5 01.4 "     |
| " .....                            | 48 23.5   | 89 13.5    | 1844   |                |                  |              |
| " .....                            | 48 23.5   | 89 13.5    | 1844   |                |                  |              |
| Fort William school .....          | 48 24.0   | 89 14.0    | 1902.8 |                |                  | 3 49.9E      |
| Fort William mission .....         | 48 24.0   | 89 14.0    | 1902.8 |                |                  | 3 32.9 "     |
| Fort William.....                  | 48 24.0   | 89 14.0    | 1906.7 |                |                  | 3 37.2 "     |
| Sturgeon bay .....                 | 48 11.0   | 89 18.0    | 1906.8 |                |                  | 2 18.1 "     |
| *Victoria island.....              | 48 05.0   | 89 21.0    | 1906.8 |                |                  | 0 31.3 "     |
| Dog portage .....                  | 48 39.0   | 89 30.0    | 1843   |                |                  |              |
| " .....                            | 48 39.0   | 89 30.0    | 1843   |                |                  |              |
| " .....                            | 48 39.0   | 89 30.0    | 1844   |                |                  |              |
| " .....                            | 48 39.0   | 89 30.0    | 1844   |                |                  |              |
| " .....                            | 48 39.0   | 89 30.0    | 1844   |                |                  |              |
| Pigeon river.....                  | 48 00.0   | 89 34.0    | 1906.8 |                |                  | 2 44.8 E     |
| *Portage Ecarte.....               | 48 25.0   | 89 44.0    | 1843   |                |                  |              |
| " .....                            | 48 25.0   | 89 44.0    | 1843   |                |                  |              |
| Prairie portage .....              | 48 57.5   | 90 01.5    | 1843   |                |                  |              |
| " .....                            | 48 57.5   | 90 01.5    | 1843   |                |                  |              |
| " .....                            | 48 57.5   | 90 01.5    | 1844   |                |                  |              |
| " .....                            | 48 57.5   | 90 01.5    | 1844   |                |                  |              |
| " .....                            | 48 57.5   | 90 01.5    | 1844   |                |                  |              |
| S. W. of Savanne portage .....     | 48 53.0   | 90 03.3    | 1825   | May 21         |                  | 9 23.9 E     |
| " .....                            | "         | "          | 1843   | June 6         | 7-52a            | 8 06.3 "     |
| " .....                            | "         | "          | 1844   | Oct. 6         | 7-12p            | 7 23.1 "     |

\* Local disturbance

SESSIONAL PAPER No. 25a

V—Con.

RESULTS—Con.

RIO—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
| May ..         |                  | 78 31.0 |                |                  |              |               |             | Dr. J. Rae.   |
|                |                  | 77 47.0 |                |                  |              | 1419          |             | L. S.         |
|                |                  | 78 34.0 |                |                  |              |               |             | Bayfield.     |
|                |                  | 81 50.0 |                |                  |              | 1016          |             | L. S.         |
|                |                  | 78 08.0 |                |                  |              | 1320          |             | L. S.         |
|                |                  | 78 18.0 |                |                  |              | 1298          |             | L. S.         |
|                |                  | 78 24.8 |                |                  |              | 1271          |             | C. I.         |
| May 26         |                  | 76 24.0 | May 26         |                  |              | 6294          |             | J. H. Lefroy. |
|                |                  |         | " 26           |                  |              | 6309          |             | "             |
|                |                  |         | " 26           |                  |              | 6291          |             | "             |
|                |                  |         |                |                  |              | 1234          |             | L. S.         |
| May 27         | 8-00a            | 79 04.0 | May 27         |                  |              | 6468          |             | J. H. Lefroy. |
|                |                  | 78 53.6 |                |                  |              |               |             |               |
| " 27           |                  | 78 46.2 | " 27           |                  |              | 6457          |             | "             |
|                |                  | 78 10.0 |                |                  |              | 1298          |             | L. S.         |
|                |                  | 78 26.0 |                |                  |              | 1021          |             | L. S.         |
|                |                  | 79 20.0 |                |                  |              | 1164          |             | L. S.         |
|                |                  | 68 48.0 |                |                  |              | 1983          |             | L. S.         |
|                |                  | 78 28.6 |                |                  |              | 1274          |             | C. I.         |
|                |                  | 78 55.0 |                |                  |              | 1251          |             | L. S.         |
|                |                  | 78 21.0 |                |                  |              | 1294          |             | L. S.         |
|                |                  | 78 06.0 |                |                  |              | 1315          |             | L. S.         |
| May 28         |                  | 78 23.2 | May 28         |                  |              | 6587          |             | J. H. Lefroy. |
| " 28           |                  | 78 30.0 | " 28           |                  |              | 6480          |             | "             |
|                |                  | 78 00.0 |                |                  |              | 1305          |             | L. S.         |
| July 14        | 2-40<br>to 3-20p | 78 09.0 | July 14        | 3-45<br>to 5-30p |              | 6402          |             | E. Deville.   |
| May 29         |                  | 78 09.7 | May 29         |                  |              | 6528          |             | J. H. Lefroy. |
| " 29           |                  | 78 10.2 | " 29           |                  |              | 6509          |             | "             |
|                |                  |         | " 29           |                  |              | 6500          |             | "             |
|                |                  |         | " 31           |                  |              | 6452          |             | "             |
|                |                  |         |                |                  |              | 6457          |             | "             |
| May 11         |                  | 78 20.0 |                |                  |              |               |             | Bayfield.     |
| Oct. 11        |                  | 78 07.5 | Oct. 11        |                  |              | 6428          |             | Franklin.     |
| " 11           |                  | 77 55.5 | " 11           |                  |              | 6423          |             | J. H. Lefroy. |
| " 11           |                  | 77 55.5 | " 11           |                  |              | 6387          |             | "             |
|                |                  | 78 11.0 |                |                  |              |               |             | Dr. J. Rae.   |
|                |                  | 77 54.6 |                |                  |              | 1332          |             | C. S.         |
|                |                  | 77 54.9 |                |                  |              | 1331          |             | C. S.         |
|                |                  | 77 48.0 |                |                  |              | 1341          |             | C. I.         |
|                |                  | 77 29.0 |                |                  |              | 1349          |             | L. S.         |
|                |                  | 77 51.0 |                |                  |              | 1348          |             | L. S.         |
| June 3         | 4-30p            | 78 26.8 | June 3         |                  |              | 6518          |             | J. H. Lefroy. |
| " 3            |                  | 78 25.0 | " 3            |                  |              | 6480          |             | "             |
|                |                  |         | Oct. 9         |                  |              | 6507          |             | "             |
|                |                  |         | " 9            |                  |              | 6533          |             | "             |
|                |                  |         | " 9            |                  |              | 6547          |             | "             |
|                |                  | 78 07.0 |                |                  |              | 1295          |             | L. S.         |
| June 2         |                  | 77 13.5 | June 2         |                  |              | 6463          |             | J. H. Lefroy. |
|                |                  |         | " 2            |                  |              | 6442          |             | "             |
| June 5         |                  | 78 26.1 | " 5            |                  |              | 6486          |             | "             |
| " 5            |                  | 78 28.2 | " 5            |                  |              | 6446          |             | "             |
|                |                  |         | Oct. 7         |                  |              | 6515          |             | "             |
|                |                  |         | " 7            |                  |              | 6560          |             | "             |
| May 20         |                  | 78 39.1 | " 7            |                  |              | 6543          |             | "             |
| Oct. 6         | 11-00a           | 78 21.8 | Oct. 6         |                  |              | 6507          |             | Franklin.     |
|                |                  |         |                |                  |              |               |             | J. H. Lefroy. |
|                |                  |         |                |                  |              |               |             | "             |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

ONTA

C. I.—Carnegie Institution.  
L. S.—Lake Survey.  
C. S.—Coast Survey.

| Place.                               | Latitude. | Longitude. | Year.  | Month and Day. | Hour and Minute. | Declination. |
|--------------------------------------|-----------|------------|--------|----------------|------------------|--------------|
| S. W. of Savanne portage             | 48 53 0   | 90 03 3    | 1844   | Oct. 6         | 7-50a            | 7 25.6 E     |
| "                                    | "         | "          | 1857   | "              | "                | 6 53.0 "     |
| Savanne                              | 48 58.0   | 90 14 0    | 1906.7 | "              | "                | 4 33.8 "     |
| French portage                       | 48 35.0   | 91 08 4    | 1843   | "              | "                | "            |
| End of the portage of the Two Rivers | 48 35.0   | 91 23 0    | 1843   | June 9         | 9-56a            | 10 57.6 "    |
| "                                    | "         | "          | 1844   | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| Imace                                | 49 25 0   | 91 40 0    | 1906.7 | "              | "                | 6 14.6 "     |
| E. end of Lac à la Crosse            | 48 24.0   | 92 04 0    | 1843   | June 10        | 7-44a            | 7 52.5 "     |
| 2nd portage, Lac à la Crosse         | 48 14.2   | 92 25.0    | "      | June 11        | 7-41a            | 10 40.3 "    |
| "                                    | "         | "          | "      | "              | 8-13a            | 10 01.0 "    |
| Sturgeon lake                        | 48 27 5   | 92 38 0    | "      | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| Farrington                           | 48 46.0   | 92 48 0    | 1906.8 | "              | "                | 7 39.2 "     |
| S. side, Lac à la Pluie              | 48 33.4   | 92 50.0    | 1843   | June 13        | 9-30a            | 10 53.6 "    |
| "                                    | "         | "          | "      | "              | "                | "            |
| Eagle river                          | 49 48.0   | 93 11 0    | 1906.7 | "              | "                | 6 39.7 "     |
| Fort Frances                         | 48 36.6   | 93 26 7    | 1825   | May 28         | "                | 10 42.6 "    |
| "                                    | "         | "          | 1843   | June 14        | 6-25p            | 10 33.3 "    |
| "                                    | "         | "          | "      | "              | 6-52p            | 10 36.7 "    |
| "                                    | "         | "          | "      | "              | 6-00             | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | 1844   | Sept. 30       | 9-26a            | 8 36.7 "     |
| "                                    | "         | "          | "      | "              | 3-17p            | 8 34.1 "     |
| "                                    | "         | "          | 1845   | "              | "                | "            |
| "                                    | "         | "          | 1857   | "              | "                | 9 31.0 "     |
| Kencra                               | 49 46 0   | 94 26 0    | 1906.7 | "              | "                | 9 54.1 "     |
| Near Rat portage, Winnipeg river     | 49 46 3   | 94 29 4    | 1885   | June 22        | 10-30a           | 11 55.7 "    |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| On N. bank of Rainy river            | 48 41 0   | 94 31 0    | 1843   | June 16        | 7-48a            | 13 04.5 "    |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| *Rainy river                         | 48 43.0   | 94 31 0    | 1906.8 | "              | "                | 9 33.8 "     |
| Rat portage                          | 49 45.9   | 94 33 3    | 1843   | June 20        | 10-11a           | 9 38.0 "     |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | 1844   | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | "         | "          | "      | "              | "                | "            |
| Winnipeg river                       | 49 53.1   | 94 34.2    | 1885   | June 25        | 10-00a           | 10 09.1 "    |
| Island in Lake of the Woods          | 49 25 0   | 94 37 0    | 1843   | June 18        | 3-14p            | 12 26.0 "    |
| "                                    | "         | "          | "      | "              | "                | "            |
| "                                    | 49 19 0   | 94 40 0    | "      | June 17        | 7-58a            | 13 42.6 "    |
| "                                    | "         | "          | "      | "              | "                | "            |
| Sand lake, Winnipeg river            | 50 02.5   | 94 41 9    | 1885   | June 28        | 10-45a           | 10 53.2 "    |
| Settlement, mouth of White Dog river | 50 08.2   | 94 54.4    | 1885   | July 1         | 5-45p            | 9 41.0 "     |

\*Local disturbance.

SESSIONAL PAPER No. 25a

V—Con.

RESULTS—Con.

RIO—Con.

| Month and Day. | Hour and Minute.    | Dip.    | Month and Day. | Hour and Minute    | Hor. Intens. | Total Intens. | Temperature. | Observer.                  |
|----------------|---------------------|---------|----------------|--------------------|--------------|---------------|--------------|----------------------------|
| Oct. 6.        |                     | 78 14.4 | Oct. 6.        |                    |              | 6499          | "            | J. H. Lefroy.<br>Palliser. |
|                |                     | 78 09.9 |                |                    | 1304         |               |              | C. I.                      |
| June 8         |                     | 78 20.4 | June 8         |                    |              | 6494          |              | J. H. Lefroy.              |
| "              |                     | 78 05.5 | "              |                    |              | 6471          |              | "                          |
| June 9         |                     | 77 49.4 | June 9         |                    |              | 6508          |              | "                          |
| "              |                     | 77 53.2 | "              |                    |              | 6473          |              | "                          |
|                |                     |         | Oct. 4         |                    |              | 6384          |              | "                          |
|                |                     |         | "              |                    |              | 6422          |              | "                          |
|                |                     |         | "              |                    |              | 6407          |              | "                          |
| June 10        | 10-00a              | 78 27.4 | June 10        |                    | 1279         | 6488          |              | C. I.                      |
|                |                     | 77 51.0 | "              |                    |              | 6474          |              | J. H. Lefroy.              |
| June 11        |                     | 77 40.1 | June 11        |                    |              | 6473          |              | "                          |
| June 12        | 1-00p               | 77 44.8 | June 12        |                    |              | 6453          |              | "                          |
|                |                     |         | "              |                    |              | 6503          |              | "                          |
|                |                     |         | "              |                    |              | 6462          |              | "                          |
|                |                     |         | "              |                    |              | 1319          |              | C. I.                      |
| June 13        |                     | 77 42.4 | June 13        |                    |              | 6515          |              | "                          |
| "              |                     | 77 47.9 | "              |                    |              | 6461          |              | "                          |
| "              |                     | 77 28.7 | "              |                    |              |               |              | "                          |
| "              |                     | 78 07.8 | "              |                    |              | 1313          |              | "                          |
| May 28         |                     | 77 18.1 | "              |                    |              |               |              | Franklin.                  |
| June 14        |                     | 77 23.0 | June 14        |                    |              | 6467          |              | J. H. Lefroy.              |
| "              |                     | 77 22.8 | "              |                    |              | 6480          |              | "                          |
|                |                     |         | "              |                    |              | 6420          |              | "                          |
|                |                     |         | "              |                    |              | 6471          |              | "                          |
|                |                     |         | "              |                    |              | 6475          |              | "                          |
|                |                     |         | Sept. 29       |                    |              | 6456          |              | "                          |
|                |                     |         | "              |                    |              | 6487          |              | "                          |
|                |                     |         | "              |                    |              | 6488          |              | "                          |
|                |                     | 77 32.0 | "              |                    |              |               |              | Dr. J. Rae.                |
|                |                     |         | "              |                    |              |               |              | Palliser.                  |
|                |                     | 77 58.9 | "              |                    |              | 1318          |              | C. I.                      |
| June 22        | 10-25a<br>to 10-45p | 78 31.3 | June 22        | 1-23<br>to 2-10p   |              | 6444          | 87           | Th. Fawcett.               |
| Oct. 19        | 8-38<br>to 9-00a    | 78 36.1 | Oct. 19        | 9-40<br>to 10-11a  |              | 6445          | 34           | "                          |
| "              | 9-03<br>to 9-35a    | 78 38.5 | "              | 10-11<br>to 10-50a |              | 6463          | 37           | "                          |
| June 16        | 9-00a               | 77 57.4 | June 16        |                    |              | 6593          |              | J. H. Lefroy.              |
| "              |                     | 78 14.9 | "              |                    |              | 6633          |              | "                          |
|                |                     |         | "              |                    |              | 6575          |              | "                          |
|                |                     |         | "              |                    |              | 1376          |              | C. I.                      |
| June 20        |                     | 77 27.2 | June 20        |                    |              | 6480          |              | J. H. Lefroy.              |
| "              |                     | 78 07.5 | "              |                    |              | 6163          |              | "                          |
| "              |                     | 78 07.1 | "              |                    |              |               |              | "                          |
| "              |                     | 78 00.5 | Sept. 25       |                    |              | 6417          |              | "                          |
|                |                     |         | "              |                    |              | 6452          |              | "                          |
|                |                     |         | "              |                    |              | 6446          |              | "                          |
| June 25        | 10-10<br>to 11-30a  | 78 28.3 | June 25        | 2-00<br>to 2 45p   |              | 6504          | 79           | Th. Fawcett.               |
| June 18        | 1-00p               | 78 16.7 | June 18        |                    |              | 6503          |              | J. H. Lefroy.              |
| "              |                     | 78 15.2 | "              |                    |              | 6413          |              | "                          |
| June 17        | 9-20a               | 78 03.7 | June 17        |                    |              | 6516          |              | "                          |
| "              |                     | 78 01.7 | "              |                    |              | 6482          |              | "                          |
| June 28        | 11-20<br>to 12-45a  | 78 31.4 | June 28        | 1-20<br>to 1 43p   |              | 6538          | 82           | Th. Fawcett.               |
| July 1.        | 6-17<br>to 7-00p    | 78 28.2 | July 1.        | 7-02<br>to 8 00p   |              | 6518          | 72           | "                          |

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TABLE  
MAGNETIC  
HUDSON BAY AND

| Place.                            | Latitude. | Longitude. | Year. | Month and day.            | Hour and minute. | Declination. |
|-----------------------------------|-----------|------------|-------|---------------------------|------------------|--------------|
| Eastmain . . . . .                | 52 14.7   | 78 29.3    | 1890  | Sept. 11 . . .            | 5-25<br>to 5-45p | 15 01.6W     |
| " . . . . .                       | "         | "          | "     | Oct. 2 . . . . .          | 4 25<br>to 4-41p | 14 51.5 "    |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| Rupert House . . . . .            | 51 29.5   | 78 43.4    | 1890  | Aug. 13. . . .            | 5-14<br>to 5 38p | 14 15.1 "    |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| At sea, Hudson bay . . . . .      | 63 17.0   | 78 55.0    | 1846  |                           |                  | 58 15.0 "    |
| " . . . . .                       | 60 10.0   | 80 10.0    | 1846  |                           |                  |              |
| " . . . . .                       | 62 10.0   | 80 10.0    | "     |                           |                  |              |
| " . . . . .                       | 52 20.0   | 80 17.0    | "     |                           |                  |              |
| " . . . . .                       | 51 32.0   | 80 34.0    | "     |                           |                  | 10 41.0 "    |
| " . . . . .                       | 53 24.0   | 81 06.0    | "     |                           |                  |              |
| " . . . . .                       | 53 42.0   | 81 09.0    | "     |                           |                  | 12 48.0 "    |
| " . . . . .                       | 60 20.0   | 81 12.0    | "     |                           |                  |              |
| " . . . . .                       | 62 20.0   | 81 12.0    | "     |                           |                  |              |
| " . . . . .                       | 53 57.0   | 81 30.0    | "     |                           |                  |              |
| " . . . . .                       | 54 43.0   | 81 32.0    | "     |                           |                  | 13 30.0 "    |
| " . . . . .                       | 56 24.0   | 81 50.0    | "     |                           |                  |              |
| " . . . . .                       | 56 40.0   | 81 57.0    | "     |                           |                  |              |
| " . . . . .                       | 60 26.0   | 82 0.80    | "     |                           |                  |              |
| " . . . . .                       | 55 25.0   | 82 14.0    | "     |                           |                  | 11 53.0 "    |
| " . . . . .                       | 55 29.0   | 82 24.0    | "     |                           |                  |              |
| " . . . . .                       | 57 15.0   | 82 33.0    | "     |                           |                  | 15 57.0 "    |
| " . . . . .                       | 57 04.0   | 82 37.0    | "     |                           |                  |              |
| " . . . . .                       | 57 32.0   | 82 37.0    | "     |                           |                  | 16 15.0 "    |
| " . . . . .                       | 57 09.0   | 82 42.0    | "     |                           |                  | 17 16.0 "    |
| " . . . . .                       | 60 25.0   | 82 42.0    | "     |                           |                  |              |
| " . . . . .                       | 59 11.0   | 82 45.0    | "     |                           |                  |              |
| " . . . . .                       | 60 45.0   | 82 45.0    | "     |                           |                  |              |
| " . . . . .                       | 61 07.0   | 82 50.0    | "     |                           |                  |              |
| " . . . . .                       | 58 53.0   | 82 52.0    | "     |                           |                  | 20 52.0 "    |
| " . . . . .                       | 57 15.0   | 82 53.0    | "     |                           |                  | 15 57.0 "    |
| On shore, Hudson bay . . . . .    | 51 08.0   | 80 44.0    | "     |                           |                  | 10 55.0 "    |
| Moose Factory . . . . .           | 51 15.0   | 80 56.0    | "     |                           |                  | 12 40.0 "    |
| " . . . . .                       | 51 15.4   | 80 40.5    | 1880  | Aug. 14, 17, 20 . . . . . |                  | 15 27.5 "    |
| " . . . . .                       | 51 14.5   | 80 56.0    | 1890  | July 24 . . . . .         | 4-15<br>to 4-48p | 15 14.7 "    |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| Fort Albany, Hudson bay . . . . . | 51 22.0   | 82 38.0    | 1775  |                           |                  |              |
| Fort Hope . . . . .               | 66 32.0   | 86 56.0    | 1846  |                           |                  |              |
| " . . . . .                       | "         | "          | "     |                           |                  |              |
| " . . . . .                       | "         | "          | 1847  |                           |                  |              |
| " . . . . .                       | "         | "          | "     |                           |                  |              |



SESSIONAL PAPER No. 25a

VI.

RESULTS.

SURROUNDING TERRITORY.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. Intens. | Total Intens. | Temperature | Observer.       |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|-----------------|
| Sept. 11       | 3-20 to 3-46p    | 80 43 4 |                |                  |              |               |             | Wm. Ogilvie.    |
| " 11           | 4-16 to 4-30p    | 80 46 7 |                |                  |              |               |             | "               |
| Oct. 2         | 2-28 to 2-57p    | 80 47 4 |                |                  |              |               |             | "               |
| " 2            | 3-35 to 3-56p    | 80 42 6 |                |                  |              |               |             | "               |
| Aug. 13        | 10-58 to 11-22a  | 80 26 6 |                |                  |              |               |             | "               |
| " 13           | 11-57 to 12-18a  | 80 34 2 |                |                  |              |               |             | "               |
| Oct. 5         | 3-47 to 4 09p    | 80 33 8 |                |                  |              |               |             | "               |
|                |                  | 86 35 0 |                |                  |              | 6248          |             | T. E. L. Moore. |
|                |                  | 87 01 0 |                |                  |              | 6160          |             | "               |
|                |                  | 87 01 0 |                |                  |              | 6160          |             | "               |
|                |                  | 81 49 0 |                |                  |              |               |             | "               |
|                |                  | 80 59 0 |                |                  |              |               |             | "               |
|                |                  | 82 20 0 |                |                  |              |               |             | "               |
|                |                  |         |                |                  |              | 6401          |             | "               |
|                |                  | 86 07 0 |                |                  |              |               |             | "               |
|                |                  | 86 07 0 |                |                  |              |               |             | "               |
|                |                  | 83 02 0 |                |                  |              | 6358          |             | "               |
|                |                  | 83 47 0 |                |                  |              | 6381          |             | "               |
|                |                  | 84 10 0 |                |                  |              |               |             | "               |
|                |                  | 84 42 0 |                |                  |              | 6248          |             | "               |
|                |                  | 85 20 0 |                |                  |              | 6257          |             | "               |
|                |                  | 84 00 0 |                |                  |              | 6266          |             | "               |
|                |                  | 83 48 0 |                |                  |              | 6114          |             | "               |
|                |                  | 84 30 0 |                |                  |              | 6266          |             | "               |
|                |                  | 84 31 0 |                |                  |              |               |             | "               |
|                |                  | 85 15 0 |                |                  |              | 6123          |             | "               |
|                |                  | 84 36 0 |                |                  |              |               |             | "               |
|                |                  | 86 36 0 |                |                  |              | 6095          |             | "               |
|                |                  | 86 30 0 |                |                  |              | 6289          |             | "               |
|                |                  | 86 41 0 |                |                  |              | 6261          |             | "               |
|                |                  | 87 00 0 |                |                  |              | 6082          |             | "               |
|                |                  | 85 48 0 |                |                  |              |               |             | "               |
|                |                  | 84 31 0 |                |                  |              | 6238          |             | "               |
|                |                  | 81 02 0 |                |                  |              | 6487          |             | "               |
|                |                  | 81 30 0 |                |                  |              | 6510          |             | "               |
|                |                  |         |                |                  |              |               |             | S. W. Very.     |
| July 22        | 10-20 to 10-48a  | 80 48 5 |                |                  |              |               |             | Wm. Ogilvie.    |
| " 23           | 11-30 to 11-57a  | 80 52 0 |                |                  |              |               |             | "               |
|                |                  | 79 20 0 |                |                  |              |               |             | Hutchins.       |
| November       |                  | 88 03 8 |                |                  |              |               |             | Dr. J. Rae.     |
| December       |                  | 88 14 0 |                |                  |              |               |             | "               |
| January        |                  | 88 17 5 |                |                  |              |               |             | "               |
| February       |                  | 88 12 2 |                |                  |              |               |             | "               |

9-10 EDWARD VII., A. 1910

TABLE

MAGNETIC

HUDSON BAY AND

| Place.                                       | Latitude. | Longitude. | Year. | Month and day. | Hour and minute. | Declination. |
|--|-----------|------------|-------|----------------|------------------|--------------|
| Repulse bay.....                             | 66 32 0   | 86 55 0    | 1846  |                |                  |              |
| Near Wager river.....                        | 65 10 0   | 87 30 0    | "     |                |                  |              |
| Three miles N. W. of cape<br>Lady Felly..... | 64 30 0   | 88 00 0    | "     |                |                  |              |
| Knapp bay.....                               | 64 06 0   | 88 00 0    | "     |                |                  |              |
| ".....                                       | 61 09 7   |            | "     |                |                  |              |
| Mouth of Albany R., Lake St.<br>Joseph.....  | 51 12 7   | 90 09 8    | 1885  | Sept. 10 ...   | 3-50p            | 6 09 0 E     |
| " " " ".....                                 | "         | "          | "     | " 11 ...       | 8-30a            | 5 33 4 "     |
| Lake St. Joseph.....                         | 51 11 2   | 90 37 0    | 1885  | Sept. 6.....   | 9-30a            | 5 22 0 "     |
| " " " ".....                                 | "         | "          | "     | " 6.....       | 4-10p            | 5 18 8 "     |
| " " " ".....*                                | 50 58 8   | 91 08 0    | "     | Aug. 29.....   | 5-50p            | 24 27 2 "    |
| " " " ".....*                                | "         | "          | "     | " 30 ...       | 10-17a           | 23 43 9 "    |
| On a portage, Root river.....                | 50 49 7   | 91 22 7    | 1885  | Aug. 23.....   | 8-00a            | 7 20 3 E     |
| " " " ".....                                 | "         | "          | "     | " 23.....      | 4-10p            | 7 07 5 "     |
| Cat river.....                               | 51 05 7   | 91 24 2    | "     | Sept. 20 ..    | 10-15a           | 5 35 3 "     |
| " " " ".....                                 | "         | "          | "     | " 20.....      | 3-33p            | 5 35 0 "     |
| Root river.....                              | 50 41 2   | 91 35 8    | "     | Aug. 16 ...    | 10-00a           | 6 55 7 "     |
| " " " ".....                                 | "         | "          | "     | " 16 ...       | 3-15p            | 6 50 6 "     |
| H. B. Co.'s post, Cat lake.....              | 51 44 3   | 91 46 2    | "     | Sept. 30 ...   | 4-00p            | 4 50 1 "     |
| " " " ".....                                 | "         | "          | "     | Oct. 1 ...     | 6-40a            | 4 31 1 "     |
| Cat river.....                               | 51 30 0   | 91 49 7    | "     | Sept. 27 ...   | 9-39a            | 5 12 3 "     |
| " " " ".....                                 | "         | "          | "     | " 27.....      | 4-13p            | 4 43 2 "     |
| Cat lake.....                                | 51 46 3   | 91 51 1    | "     |                |                  |              |
| " " " ".....                                 | "         | "          | "     |                |                  |              |
| Lac Seul.....                                | 50 23 7   | 92 04 8    | "     | Aug. 9 ...     | 9-20a            | 8 22 4 E     |
| " " " ".....                                 | "         | "          | "     | " 9 . .        | 4-40p            | 8 09 1 "     |
| H. B. Co.'s post, Lac Seul ..                | 50 19 5   | 92 14 4    | "     | " 6.....       | 4-30p            | 7 03 9 "     |
| " " " ".....                                 | "         | "          | "     | " 7.....       | 10-00a           | 7 09 4 "     |
| At a creek.....                              | 58 02 0   | 92 20 0    | 1846  |                |                  |              |
| York Factory.....                            | 56 59 9   | 92 26 0    | 1843  | July 24.....   | 6-07p            | 9 37 8 E     |
| " " " ".....                                 | "         | "          | "     | " 24.....      | 6-40p            | 9 07 8 "     |
| " " " ".....                                 | "         | "          | "     | " 26.....      | 7-21a            | 8 16 2 "     |
| " " " ".....                                 | "         | "          | "     | " 26.....      | 7-36a            | 9 00 8 "     |
| " " " ".....                                 | "         | "          | "     |                |                  |              |
| " " " ".....                                 | "         | "          | "     |                |                  |              |
| " " " ".....                                 | "         | "          | 1845  |                |                  |              |

\* Local disturbance.

SESSIONAL PAPER No. 25a

VI—Con.

RESULTS—Con.

SURROUNDING TERRITORY—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
| July 27.....   |                  | 88 16.7 |                |                  |              |               |             | Dr. J. Rae.   |
|                |                  | 87 10.6 |                |                  |              |               |             | "             |
| Aug. 3.....    |                  | 88 27.1 |                |                  |              |               |             | "             |
|                |                  | 86 36.5 |                |                  |              |               |             | "             |
| July 8.....    |                  | 86 47.3 |                |                  |              |               |             | "             |
|                | 4-12             |         |                | 5-00             |              |               |             |               |
| Sept. 10....   | to 4-53p         | 80 18.3 | Sept. 10....   | to 5-25p         |              | 6481          | 60          | Th. Fawcett.  |
|                | 9-00             |         |                | 9-35             |              |               |             |               |
| " 11....       | to 9-30a         | 80 21.4 | " 11....       | to 10-00a        |              | 6484          | 56          | "             |
|                | 10-00            |         |                | 10-35            |              |               |             |               |
| " 6....        | to 10-30a        | 80 25.3 | " 6....        | to 11-00a        |              | 6450          | 52          | "             |
|                | 4-35             |         |                | 5-55             |              |               |             |               |
| " 6....        | to 5-00p         | 80 19.0 | " 6....        | to 6-20p         |              | 6463          | 48          | "             |
|                | 6-10             |         |                | 6-40             |              |               |             |               |
| Aug. 29....    | to 6-38p         | 81 46.6 | Aug. 29....    | to 7-04p         |              | 6435          | 55          | "             |
|                | 10-20            |         |                | 11-56            |              |               |             |               |
| " 30....       | to 10-40a        | 81 48.8 | " 30....       | to 12-15a        |              | 6413          | 61          | "             |
|                | 8-27             |         |                | 9-00             |              |               |             |               |
| " 23....       | to 8-55a         | 79 42.1 | Aug. 23....    | to 9-26a         |              | 6513          | 51          | "             |
|                | 4-26             |         |                | 4-56             |              |               |             |               |
| " 23....       | to 4-54p         | 79 39.4 | " 23....       | to 5-15p         |              | 6500          | 48          | "             |
|                | 10-15            |         |                | 11-10            |              |               |             |               |
| Sept. 20....   | to 11-08a        | 80 05.7 | Sept. 20....   | to 11-40a        |              | 6491          | 70          | "             |
|                | 4-03             |         |                | 4-35             |              |               |             |               |
| " 20....       | to 4-30p         | 80 04.5 | " 20....       | to 5-00p         |              | 6493          | 60          | "             |
|                | 0-08             |         |                | 0-35             |              |               |             |               |
| Aug. 16....    | to 6-33p         | 79 27.1 | Aug. 16....    | to 1-00p         |              | 6526          | 67          | "             |
|                | 3-28             |         |                | 3-54             |              |               |             |               |
| " 16....       | to 3-52p         | 79 26.1 | " 16....       | to 4-10p         |              | 6516          | 70          | "             |
|                | 4-00             |         |                | 4-32             |              |               |             |               |
| Sept. 30....   | to 4-30p         | 80 29.0 | Sept. 30....   | to 5-00p         |              | 6497          | 46          | "             |
|                | 7-40             |         |                | 8-18             |              |               |             |               |
| Oct. 1....     | to 8-10a         | 80 29.0 | Oct. 1....     | to 8-42a         |              | 6475          | 47          | "             |
|                | 10-02            |         |                | 10-26            |              |               |             |               |
| Sept. 27....   | to 10-24a        | 80 11.6 | Sept. 27....   | to 11-00a        |              | 6533          | 67          | "             |
|                | 4-35             |         |                | 5-09             |              |               |             |               |
| " 27....       | to 5-07p         | 80 07.0 | " 27....       | to 5-25p         |              | 6548          | 61          | "             |
|                | 3-26             |         |                | 4-20             |              |               |             |               |
| Oct. 1....     | to 4-15p         | 80 24.6 | Oct. 1....     | to 5-07p         |              | 6538          | 55          | "             |
|                |                  |         |                | 5-08             |              |               |             |               |
| 1....          | 4-17p            | 80 21.8 | " 1....        | to 5-39p         |              | 6523          | 55          | "             |
|                | 4-40             |         |                | 5-38             |              |               |             |               |
| Aug. 9....     | to 5-35p         | 79 03.9 | Aug. 9....     | to 6-00p         |              | 6557          | 72          | "             |
|                | 6-07             |         |                | 10-36            |              |               |             |               |
| " 9....        | to 6-30p         | 79 04.9 | " 9....        | to 11-00         |              | 6539          | 70          | "             |
|                | 4-43             |         |                | 5-18             |              |               |             |               |
| " 6....        | to 5-12p         | 79 35.3 | " 6....        | to 5-40p         |              | 6534          | 70          | "             |
|                | 10-00            |         |                | 10-35            |              |               |             |               |
| " 7....        | to 10-33a        | 79 34.4 | " 7....        | to 11-00a        |              | 6537          | 69          | "             |
| June 20....    |                  | 84 46.4 |                |                  |              |               |             | Dr. J. Rae.   |
| July 24....    | 11-00a           | 83 50.5 | July 24....    |                  |              | 6492          |             | J. H. Lefroy. |
| " 24....       | 3-00p            | 83 44.0 | " 24....       |                  |              | 6481          |             | "             |
|                |                  |         | " 25....       |                  |              | 6500          |             | "             |
|                |                  |         | " 25....       |                  |              | 6433          |             | "             |
|                |                  |         | " 25....       |                  |              | 6460          |             | "             |
|                |                  |         | " 26....       |                  |              | 6495          |             | "             |
|                |                  |         | " 26....       |                  |              | 6494          |             | "             |
| Dec. 3....     |                  | 83 54.2 |                |                  |              |               |             | Dr. J. Rae.   |

9-10 EDWARD VII., A. 1910

TABLE

MAGNETIC

HUDSON BAY AND

| Place.  | Latitude. |      | Longitude. |       | Year. | Month and day. | Hour and minute.           | Declination. |
|---|-----------|------|------------|-------|-------|----------------|----------------------------|--------------|
|   | °         | '    | °          | '     |       |                |                            |              |
| York Factory.....                               | 56        | 59 9 | 92         | 26 0  | 1846  |                |                            |              |
| " .....   | "         | "    | "          | "     | 1847  |                |                            |              |
| " .....   | "         | "    | "          | "     | 1857  |                |                            |              |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | "         | "    | "          | "     | 1884  | Sept. 12....   | 10-15<br>to 11-53a<br>9-20 | 6 45·0 E     |
| " .....   | "         | "    | "          | "     | "     | " 13....       | to 9-46a                   | 6 32·0 "     |
| Shanty narrows, Lac Seul.....                   | 50        | 29 3 | 92         | 51 57 | 1885  | Aug. 1....     | 5-33p                      | 6 54·7 "     |
| " .....   | "         | "    | "          | "     | "     | " 2....        | 7-47a                      | 7 15·7 "     |
| Jct. of the Shamattawa and<br>Hayes rivers..... | 56        | 21 0 | 93         | 00 0  | 1843  | July 22....    | 6-15p                      | 10 00·0 "    |
| " .....   | "         | "    | "          | "     | "     | " 28....       | 4-03p                      | 12 19·6 "    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| English river.....                              | 50        | 38 9 | 93         | 10 2  | 1885  | July 29....    | 5-30p                      | 9 21·0 E     |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| Camping lake, English river...                  | 50        | 38 1 | 93         | 24 1  | "     | July 26....    | 9-40a                      | 8 20·0 "     |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| White Mud portage .....                         | 55        | 33 0 | 93         | 44 6  | 1843  | July 31....    | 7-19a                      | 10 51·0 E    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| Tide lake, English river.....                   | 50        | 20 6 | 93         | 57 0  | 1885  | July 18....    | 6-15p                      | 9 24·8 E     |
| " .....   | "         | "    | "          | "     | "     | " 19....       | 7-30a                      | 9 23 8 "     |
| Devils Landing Place .....                      | 54        | 24 0 | 94         | 00 0  | 1844  | Aug. 1....     | 8-24a                      | 11 49·4 "    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| Grassy narrows, English river..                 | 50        | 10 7 | 94         | 02 2  | 1885  | July 15....    | 5-00p                      | 9 28 0 "     |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| Fort Churchill.....                             | 58        | 43 8 | 94         | 14 0  | 1846  | June 29....    | a.m.                       | 12 43·0 E.   |
| " .....   | "         | "    | "          | "     | "     | July 1....     | p.m.                       | 11 29 0 "    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| Long portage .....                              | 55        | 14 0 | 94         | 22 0  | 1819  | Sept.....      |                            | 11 10·4 E.   |
| " .....   | "         | "    | "          | "     | 1843  | July 20....    | 5-42a                      | 12 59·4 "    |
| " .....   | "         | "    | "          | "     | "     | Aug. 2....     | 6-29a                      | 12 13 5 "    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| English river.....                              | 50        | 16 0 | 94         | 30 6  | 1885  | July 12....    | 8-10a                      | 9 44·7 E.    |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | 50        | 21 8 | 94         | 39 3  | "     | " 9....        | 6-00p                      | 10 21·2 E.   |
| " .....   | "         | "    | "          | "     | "     |                |                            |              |
| " .....   | 50        | 14 5 | 94         | 59 3  | "     | July 5....     | 9-50a                      | 9 07·0 E.    |

SESSIONAL PAPER No. 25a

VI—Con.

RESULTS—Con.

SURROUNDING TERRITORY—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
| Feb. 9         |                  | 83 42.9 |                |                  |              |               |             | Dr. J. Rae.   |
| April 25       |                  | 83 35.5 |                |                  |              |               |             | "             |
| Sept. 18       |                  | 83 47.0 |                |                  |              |               |             | "             |
| Aug. 9         |                  | 83 53.0 |                |                  |              | 6466          |             | Blakiston.    |
|                |                  |         |                |                  |              | 6463          |             | "             |
| Sept. 11       | 3-05 to 3-40p    | 83 47.2 | Sept. 11       | 3-45 to 4-10p    |              | 6419          |             | Otto Klotz.   |
| " 11           | 4-18 to 4-56p    | 83 46.7 | " 11           | 3-45 to 4-10p    |              | 6423          |             | "             |
|                | 5-35 to 6-20p    |         |                | 6-25 to 6-50p    |              |               |             |               |
| Aug. 1         | 8-00 to 8-55a    | 79 16.3 | Aug. 1         | 9-00 to 9-32a    |              | 6557          | 59          | Th. Fawcett.  |
| " 2            |                  | 79 14.9 | " 2            |                  |              | 6520          | 78          | "             |
| July 28        | 4 00p            | 83 36.2 | July 22        |                  |              | 6598          |             | J. H. Lefroy. |
| " 22           |                  | 83 41.6 | " 28           |                  |              | 6534          |             | "             |
| " 28           |                  | 83 30.2 | " 22           |                  |              | 6504          |             | "             |
|                |                  |         | " 28           |                  |              | 6496          |             | "             |
| July 29        | 5-50 to 6-30p    | 79 10.8 | " 29           | 6-40 to 7-06p    |              | 6486          | 74          | Th. Fawcett.  |
| " 29           | 7-36 to 8-10p    | 79 13.0 | " 29           | 7-36 to 8-10p    |              | 6474          | 71          | "             |
| " 26           | 9-40 to 11-00a   | 79 16.1 | " 26           | 11-05 to 11-48a  |              | 6477          | 75          | "             |
| " 26           | 4-00 to 4-28p    | 79 18.2 | " 26           | 4-30 to 5-05p    |              | 6463          | 67          | "             |
| " 21           | 1 00p            | 83 02.9 | " 21           |                  |              | 6552          |             | J. H. Lefroy. |
| " 21           |                  | 83 11.6 | " 31           |                  |              | 6511          |             | "             |
| " 31           |                  | 83 00.0 | " 21           |                  |              | 6484          |             | "             |
|                |                  |         | " 31           |                  |              | 6472          |             | "             |
| July 18        | 6-15 to 7-25p    | 79 20.0 | " 18           | 7-30 to 8-05p    |              | 6460          | 60          | Th. Fawcett.  |
| " 19           | 9-30 to 10-35a   | 79 22.9 | " 19           | 10-40 to 11-25a  |              | 6486          | 63          | "             |
| Aug. 1         |                  | 82 55.0 | Aug. 1         |                  |              | 6576          |             | J. H. Lefroy. |
|                |                  |         | " 1            |                  |              | 6512          |             | "             |
| July 15        | 5-00 to 5-50p    | 79 09.3 | July 15        | 6-00 to 6-30p    |              | 6429          | 74          | Th. Fawcett.  |
| " 15           | 7-30 to 8-00p    | 79 02.5 | " 15           | 8-15 to 8-50p    |              | 6471          | 65          | "             |
| June 29        |                  | 84 57.5 |                |                  |              |               |             | Dr. J. Rae.   |
| " 29           |                  | 84 44.2 |                |                  |              |               |             | "             |
| July 1         |                  | 84 33.9 |                |                  |              |               |             | "             |
| " 1            |                  | 84 53.8 |                |                  |              |               |             | "             |
| " 4            |                  | 84 44.5 |                |                  |              |               |             | "             |
| July 19        | 4-30p            | 82 13.9 | July 20        |                  |              | 6543          |             | Franklin.     |
| " 20           |                  | 82 21.3 | Aug. 2         |                  |              | 6566          |             | J. H. Lefroy. |
| Aug. 2         |                  | 82 32.2 | " 2            |                  |              | 6540          |             | "             |
|                |                  |         | July 20        |                  |              | 6568          |             | "             |
|                |                  |         | Aug. 2         |                  |              | 6534          |             | "             |
| July 12        | 9-06 to 9-45a    | 79 19.0 | July 12        | 10-25 to 10-46   |              | 6405          | 83          | Th. Fawcett.  |
| " 12           | 10-50 to 11-52a  | 79 13.6 | " 12           | 0-00 to 0-35p    |              | 6414          | 75          | "             |
| " 9            | 6-00 to 7-00p    | 79 25.9 | " 9            | 7-30 to 7-55p    |              | 6435          | 54          | "             |
| " 9            | 8-00 to 8-40p    | 79 18.7 | " 10           | 7-00 to 7-20a    |              | 6457          | 64          | "             |
| " 5            | 9-15 to 11-10a   | 79 08.0 | " 5            | 0-10 to 0-32p    |              | 6464          | 89          | "             |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC  
HUDSON BAY AND

| Place.  | Latitude. | Longitude. | Year. | Month and day.  | Hour and minute. | Declination. |
|---|-----------|------------|-------|-----------------|------------------|--------------|
|   | ° ' "     | ° ' "      |       |                 |                  | ° ' "        |
| * Oxford House . . . . .                        | 54 56 0   | 95 30 0    | 1843  | Aug. 3 . . . .  | 5-10p            | 10 31.5 E.   |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| Hell Gate, Upper portage . . . . .              | 54 42 0   | 96 10 0    | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| East end Split lake, Nelson river . . . . .     | 56 13 3   | 96 18 8    | 1884  | " . . . . .     | " . . . . .      | " . . . . .  |
| South end of White Fall portage . . . . .       | 54 23 3   | 96 31 0    | 1843  | Aug. 5 . . . .  | 3-36p            | 17 32.0 E.   |
| South end of White Fall portage . . . . .       | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| Nelson river . . . . .                          | 55 20 8   | 97 06 3    | 1884  | " . . . . .     | " . . . . .      | " . . . . .  |
| Hairy lake, mouth of R. Echimamish . . . . .    | 54 20 0   | 97 28 0    | 1843  | July 15 . . . . | 4-00p            | 18 43.7 E.   |
| Hairy lake, mouth of R. Echimamish . . . . .    | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| Nelson river, on an island of granite . . . . . | 54 16 8   | 97 46 4    | 1884  | July 27 . . . . | 5-40p            | 16 11.0 E.   |
| Nelson river . . . . .                          | 54 50 1   | 98 11 8    | 1884  | " . . . . .     | " . . . . .      | " . . . . .  |
| Duck Nest, Lake Winnipeg . . . . .              | 53 15 5   | 97 33 5    | 1886  | Aug. 3 . . . .  | 8-45a            | 16 41.6 E.   |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| Old Norway House . . . . .                      | 53 41 6   | 98 01 4    | 1819  | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | 1843  | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| Norway House . . . . .                          | 53 59 6   | 98 03 9    | 1843  | July 13 . . . . | 6-45p            | 16 21.9 E.   |
| " . . . . .                                     | " "       | " "        | "     | " 13 . . . . .  | 7-04p            | 16 00 0 "    |
| " . . . . .                                     | " "       | " "        | "     | " 13 . . . . .  | 7-10p            | 15 58 6 "    |
| " . . . . .                                     | " "       | " "        | "     | " 13 . . . . .  | 7-30p            | 15 12 1 "    |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | 1844  | Sept. 6 . . . . | 5-22p            | 14 51.0 E.   |
| " . . . . .                                     | " "       | " "        | "     | " 7 . . . . .   | 9-12a            | 15 22 0 "    |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |
| " . . . . .                                     | " "       | " "        | 1884  | July 22 . . . . | 4-30p            | 14 55.0 E.   |
| " . . . . .                                     | " "       | " "        | "     | " 24 . . . . .  | 4-30p            | 14 59 0 "    |
| " . . . . .                                     | " "       | " "        | "     | Oct. 4 . . . .  | 3-15p            | 15 00 0 "    |
| " . . . . .                                     | " "       | " "        | "     | " . . . . .     | " . . . . .      | " . . . . .  |

\* Local disturbance.

SESSIONAL PAPER No. 25a

VI—*Con.*

RESULTS—*Con.*

SURROUNDING TERRITORY—*Con.*

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.      |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|----------------|
| Aug. 3....     | 5-30p            | 82 38.8 | Aug. 3....     |                  |              | 6568          |             | J. H. Lefroy.  |
| " 3....        |                  | 82 43.4 | " 3....        |                  |              | 6542          |             | "              |
|                |                  |         | " 3....        |                  |              | 6548          |             | "              |
| Aug. 4....     | 1-30p            | 81 57.0 | " 4....        |                  |              | 6557          |             | "              |
| " 4....        |                  | 81 53.5 | " 4....        |                  |              | 6540          |             | "              |
|                |                  |         | " 4....        |                  |              | 6544          |             | "              |
|                |                  |         | " 4....        |                  |              | 6509          |             | "              |
| Aug. 17....    | 4-10<br>to 4-55p | 82 49.9 | " 17....       | 5-05<br>to 5-39p |              | 6453          | 61          | Otto Klotz.    |
| " 5....        | 1-00p            | 81 47.9 | " 5....        |                  |              | 6537          |             | J. H. Lefroy.  |
| " 5....        |                  | 81 51.6 | " 5....        |                  |              | 6524          |             | "              |
| " 10....       | 4-45<br>to 5-25p | 81 58.1 | " 10....       | 5-30<br>to 5-55p |              | 6593          | 68          | Otto Klotz.    |
| July 15....    | 4-30p            | 81 20.9 | July 15....    |                  |              | 6487          |             | J. H. Lefroy.  |
|                |                  |         | " 15....       |                  |              | 6183          |             | "              |
| July 27....    | 3-45<br>to 4-35p | 81 23.8 | " 27....       | 4-45<br>to 5-15p |              | 6512          | 69          | Otto Klotz.    |
|                | 5-34             |         |                | 6-17             |              |               |             |                |
| Aug 3....      | to 6-13p         | 82 24.3 | Aug. 3....     | to 6-14p         |              | 6428          | 67          | "              |
|                | 9-00             |         |                | 10-30            |              |               |             |                |
| " 3....        | to 10-00a        | 80 50.8 | " 3....        | to 11-30a        |              | 5996          |             | F. W. Wilkins. |
|                | 1-30             |         |                | 2-45             |              |               |             |                |
| " 3....        | to 2-30p         | 80 46.8 | " 3....        | to 3-30p         |              | 6026          |             | "              |
| Oct. 7....     |                  | 83 40.0 |                |                  |              |               |             | Franklin.      |
| Aug. 12....    |                  | 80 45.4 | Aug. 12....    |                  |              | 6506          |             | J. H. Lefroy.  |
| " 12....       |                  | 80 49.4 | " 12....       |                  |              | 6552          |             | "              |
|                |                  |         | " 12....       |                  |              | 6551          |             | "              |
| July 12....    |                  | 81 11.0 | July 13....    |                  |              | 6536          |             | "              |
| " 13....       |                  | 81 06.2 | Aug. 8....     |                  |              | 6522          |             | "              |
| Aug. 9....     |                  | 81 09.4 | " 8....        |                  |              | 6531          |             | "              |
|                |                  |         | " 9....        |                  |              | 6503          |             | "              |
|                |                  |         | July 14....    |                  |              | 6514          |             | "              |
|                |                  |         | " 14....       |                  |              | 6513          |             | "              |
| Sept. 7....    | a.m.             | 81 11.1 | Sept. 6....    |                  |              | 6475          |             | "              |
| " 7....        |                  | 81 11.4 | " 6....        |                  |              | 6515          |             | "              |
|                |                  |         | " 6....        |                  |              | 6540          |             | "              |
|                |                  |         | " 6....        |                  |              | 6530          |             | "              |
|                |                  |         | " 6....        |                  |              | 6560          |             | "              |
| July 23....    | 2-43<br>to 3-32p | 81 05.4 | July 23....    | 3-40<br>to 4-06p |              | 6525          | 80          | Otto Klotz.    |
|                | 4-12             |         |                | 5-02             |              |               |             |                |
| " 23....       | to 4-59p         | 81 12.0 | " 23....       | to 5-19p         |              | 6489          | 70          | "              |
|                | 9-30             |         |                | 10-50            |              |               |             |                |
| Oct. 4....     | to 10-45a        | 81 18.0 | Oct. 4....     | to 11-15a        |              | 6459          | 52          | "              |
|                | 0-00             |         |                | 1-00             |              |               |             |                |
| " 4....        | to 0-50p         | 81 15.8 | " 4....        | to 1-20p         |              | 6463          | 53          | "              |

TABLE  
MAGNETIC

C.I.—Carnegie Institution.

MANI

| Place.   | Latitude. |       | Longitude. |        | Year.  | Month and day. | Hour and minute. | Declination. |        |
|--|-----------|-------|------------|--------|--------|----------------|------------------|--------------|--------|
|  | c         | r     | c          | r      |        |                |                  | c            | r      |
| Winnipeg river.....                                | 50        | 10 2  | 95         | 12 0   | 1843   | June 21.....   | 5-12p            | 12           | 28 7 E |
| Slave falls.....                                   | 50        | " 4 7 | 95         | " 40 0 | 1843   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| Badger.....  | 49        | 12 0  | 95         | 56 0   | 1906 8 | .....          | .....            | 11           | 05 0 " |
| Fort Alexander.....                                | 50        | 36 9  | 96         | 22 0   | 1825   | June 5.....    | .....            | 15           | 15 7 " |
| ".....   | "         | "     | "          | "      | 1834   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | 1843   | June 25.....   | 6-37p            | 13           | 29 0 " |
| ".....   | "         | "     | "          | "      | "      | " 26.....      | 4-49a            | 14           | 25 3 " |
| ".....   | "         | "     | "          | "      | 1844   | Sept. 20.....  | 7-39a            | 14           | 03 4 " |
| ".....   | "         | "     | "          | "      | "      | " 20.....      | 8-26a            | 14           | 04 2 " |
| *Big island, Lake Winnipeg...                      | 51        | 04 0  | 96         | 26 0   | 1844   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| Bay of Winnipeg river, Lake Winnipeg.....          | 50        | 41 7  | 96         | 31 4   | 1886   | June 23.....   | 9-00a            | 12           | 40 2 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| Lake Winnipeg.....                                 | 50        | 35 0  | 96         | 35 6   | 1843   | June 26.....   | 6-06p            | 13           | 41 0 " |
| ".....   | 50        | 33 4  | 96         | 36 0   | 1843   | .....          | .....            | .....        | .....  |
| About six miles N. of Loon creek, Lake Winnipeg... | 51        | 36 9  | 96         | 37 3   | 1886   | July 9.....    | 8 45a            | 14           | 41 6 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| *Lake Winnipeg, on an island.                      | 51        | 34 0  | 96         | 43 0   | 1844   | Sept. 17.....  | 9-36a            | 15           | 06 7 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| Selkirk.....                                       | 50        | 09 2  | 96         | 51 8   | 1886   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| On Red river.....                                  | 50        | 18 2  | 96         | 52 0   | 1843   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| West Selkirk.....                                  | 50        | 10 0  | 96         | 52 0   | 1907 8 | .....          | .....            | 13           | 16 8 " |
| *Opposite Bull's Head, Lake Winnipeg.....          | 51        | 36 7  | 96         | 53 0   | 1843   | July 6.....    | 7-59a            | 16           | 25 1 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| On Red river.....                                  | 51        | 36 0  | 96         | 56 0   | 1843   | July 5.....    | 6-53p            | 13           | 40 9 " |
| ".....   | "         | "     | "          | "      | "      | " 5.....       | 7-05p            | 13           | 10 5 " |
| ".....   | "         | "     | "          | "      | "      | July 5.....    | 7-19p            | 14           | 04 2 " |
| Island east of Bear island, Lake Winnipeg.....     | 51        | 46 0  | 97         | 00 0   | 1843   | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| *Lake Winnipeg.....                                | 51        | 44 5  | 97         | 02 0   | 1844   | Sept. 16.....  | 9-05a            | 15           | 24 2 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| Winnipeg.....                                      | 49        | 52 0  | 97         | 09 0   | 1906 7 | .....          | .....            | 13           | 56 1 " |
| Lake Winnipeg.....                                 | 52        | 20 9  | 97         | 10 0   | 1844   | Sept. 14.....  | 3-48p            | 16           | 54 6 " |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |
| ".....   | "         | "     | "          | "      | "      | .....          | .....            | .....        | .....  |

\* Local disturbance.



## SESSIONAL PAPER No. 25a

## VII.

## RESULTS.

## TOBA.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.      |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|----------------|
| June 21.....   | .....            | 79 10.0 | June 21.....   | .....            | .....        | 6549          | .....       | J. H. Lefroy.  |
| " 21.....      | .....            | 79 11.3 | .....          | .....            | .....        | .....         | .....       | "              |
| June 23.....   | .....            | 78 57.1 | June 23.....   | .....            | .....        | 6498          | .....       | "              |
| " 23.....      | .....            | 78 56.0 | .....          | .....            | .....        | .....         | .....       | "              |
| .....          | .....            | 77 36.4 | .....          | .....            | .....        | 1369          | .....       | C. I.          |
| June 5.....    | .....            | 78 47.1 | .....          | .....            | .....        | .....         | .....       | Franklin.      |
| .....          | .....            | 78 54.0 | .....          | .....            | .....        | .....         | .....       | Back.          |
| June 25.....   | .....            | 78 51.8 | June 25.....   | .....            | .....        | 6477          | .....       | J. H. Lefroy.  |
| " 25.....      | .....            | 78 55.8 | .....          | .....            | .....        | .....         | .....       | "              |
| Sept. 30.....  | .....            | 79 03.4 | Sept. 19.....  | .....            | .....        | 6561          | .....       | "              |
| " 30.....      | .....            | 79 02.5 | " 19.....      | .....            | .....        | 6564          | .....       | "              |
| .....          | .....            | .....   | " 19.....      | .....            | .....        | 6527          | .....       | "              |
| Sept. 18.....  | a. m.            | 79 31.5 | Sept. 18.....  | .....            | .....        | 6685          | .....       | "              |
| .....          | .....            | .....   | " 18.....      | .....            | .....        | 6688          | .....       | "              |
| .....          | .....            | .....   | " 18.....      | .....            | .....        | 6765          | .....       | "              |
| .....          | 9-30             | .....   | .....          | 10-45            | .....        | .....         | .....       | .....          |
| June 23.....   | to 10-30a        | 78 59.4 | June 23.....   | to 11-45a        | .....        | 5999          | 71          | F. W. Wilkins. |
| .....          | 1-30             | .....   | .....          | 2-45             | .....        | .....         | .....       | .....          |
| " 23.....      | to 2-20p         | 78 58.2 | " 23.....      | to 3-45p         | .....        | 5964          | 70          | "              |
| .....          | 7-00p            | 78 34.4 | June 26.....   | .....            | .....        | 6514          | .....       | J. H. Lefroy.  |
| June 26.....   | .....            | 79 05.1 | .....          | .....            | .....        | .....         | .....       | "              |
| " 27.....      | 0-15             | .....   | .....          | 1-45             | .....        | .....         | .....       | .....          |
| .....          | to 1-30p         | 78 49.5 | July 9.....    | to 2-30p         | .....        | 5981          | 78          | F. W. Wilkins. |
| .....          | 9-00             | .....   | .....          | 10-30            | .....        | .....         | .....       | .....          |
| " 9.....       | to 10-00a        | 78 48.9 | " 9.....       | to 11-15a        | .....        | 6004          | 72          | "              |
| .....          | .....            | .....   | Sept. 17.....  | .....            | .....        | 6646          | .....       | J. H. Lefroy.  |
| Sept. 17.....  | .....            | 79 06.1 | " 17.....      | .....            | .....        | 6623          | .....       | "              |
| .....          | .....            | .....   | " 17.....      | .....            | .....        | 6639          | .....       | "              |
| .....          | 12-00            | .....   | .....          | 1-30             | .....        | .....         | .....       | .....          |
| June 7.....    | to 1-15p         | 78 22.8 | June 7.....    | to 3-00p         | .....        | 6008          | 69          | F. W. Wilkins. |
| .....          | 9-00             | .....   | .....          | 11-00            | .....        | .....         | .....       | .....          |
| " 8.....       | to 10-40a        | 78 20.6 | " 8.....       | to 12-00a        | .....        | 6025          | 70          | "              |
| .....          | .....            | .....   | July 4.....    | .....            | .....        | 6492          | .....       | J. H. Lefroy.  |
| July 4.....    | .....            | 78 34.0 | " 4.....       | .....            | .....        | 6515          | .....       | "              |
| .....          | .....            | .....   | .....          | .....            | .....        | 1256          | .....       | C. I.          |
| .....          | .....            | 78 45.6 | .....          | .....            | .....        | .....         | .....       | .....          |
| July 6.....    | 6-30p            | 79 38.0 | July 6.....    | .....            | .....        | 6660          | .....       | J. H. Lefroy.  |
| .....          | .....            | .....   | " 6.....       | .....            | .....        | 6687          | .....       | "              |
| July 5.....    | 8-00p            | 79 11.8 | July 5.....    | .....            | .....        | 6490          | .....       | "              |
| " 5.....       | .....            | 79 01.2 | " 5.....       | .....            | .....        | 6514          | .....       | "              |
| .....          | .....            | .....   | .....          | .....            | .....        | .....         | .....       | "              |
| .....          | .....            | .....   | .....          | .....            | .....        | .....         | .....       | "              |
| July 7.....    | 1-00p            | 79 28.3 | July 7.....    | .....            | .....        | 6638          | .....       | "              |
| " 7.....       | .....            | 79 28.8 | " 7.....       | .....            | .....        | 6658          | .....       | "              |
| " 7.....       | .....            | 79 32.2 | " 7.....       | .....            | .....        | 6649          | .....       | "              |
| Sept. 16.....  | .....            | 79 39.0 | Sept. 16.....  | .....            | .....        | 7074          | .....       | "              |
| .....          | .....            | .....   | " 16.....      | .....            | .....        | 7091          | .....       | "              |
| .....          | .....            | .....   | " 16.....      | .....            | .....        | 7112          | .....       | "              |
| .....          | .....            | 78 10.3 | .....          | .....            | .....        | 1304          | .....       | C. I.          |
| Sept. 14.....  | .....            | 80 24.4 | Sept. 14.....  | .....            | .....        | 6633          | .....       | J. H. Lefroy.  |
| .....          | .....            | .....   | " 14.....      | .....            | .....        | 6655          | .....       | "              |
| .....          | .....            | .....   | " 14.....      | .....            | .....        | 6625          | .....       | "              |

TABLE  
MAGNETIC

C. I.—Carnegie Institution.

MANI

| Place.  | Latitude. | Longitude. | Year.  | Month and day.              | Hour and minute. | Declination. |
|---|-----------|------------|--------|-----------------------------|------------------|--------------|
| Wesleyan Mission, Berens riv.                             | 52 22.6   | 97 12 0    | 1843   | July 8.....                 | 6-52p            | 11 13.3 E    |
| Fort Garry.....   | 49 53.2   | 97 15.6    | 1843   | " 8.....                    | 7-04p            | 14 20.7 "    |
| ".....  | "         | "          | "      | " 30.....                   | 7-18p            | 16 42.1 "    |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| Winnipeg, C.P.R. station.....                             | 49 53.5   | 97 08.0    | 1882   | ".....                      | ".....           | ".....       |
| Winnipeg.....   | 49 52.0   | 97 09.0    | 1908   | July 16, 17,<br>18, 20..... | 10-30a           | 13 58.6      |
| Near Leaf river, Lake Winni-<br>peg.....                  | 52 31.6   | 97 18.0    | 1843   | July 10....                 | 8-03a            | 19 12.2 E    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| Four miles south of War Path<br>river, Lake Winnipeg..... | 52 18.3   | 98 14.6    | 1886   | Sept. 22. . .               | 9-00a            | 15 48.4 "    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| End of Long point, " Lake<br>Winnipeg.....                | 53 02.5   | 98 27.5    | 1886   | Sept. 9. . .                | 8-45a            | 15 39.1 "    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| North side of Long point,<br>Lake Winnipeg.....           | 53 04.2   | 98 44.5    | 1886   | Sept. 6. . . .              | 8-45a            | 17 31.8 "    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| North end of Limestone bay,<br>Lake Winnipeg.....         | 53 53.8   | 98 48.7    | 1886   | Aug. 19. . . .              | 8-15a            | 15 13.8 "    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| Lake Winnipeg.....  | 53 31.9   | 99 12.0    | 1843   | Aug. 14. . . .              | 8-14a            | 17 07.3 "    |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| Grand Rapids, east end.....                               | 53 08.1   | 99 27.0    | 1843   | Aug. 15.....                | 4-14p            | 19 12.9 "    |
| " " ".....  | "         | "          | 1844   | Sept. 2. . . .              | 9-43a            | 17 25.0 "    |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| " " ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| H. B. Co.'s post, Grand Rapids                            | 53 13.4   | 99 29.0    | 1884   | July 17.....                | 6 15p            | 15 38.0 "    |
| Cross lake.....   | 53 10.1   | 99 34.0    | 1843   | Aug. 16.....                | 9-34a            | 18 03.7 "    |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| ".....  | "         | "          | "      | ".....                      | ".....           | ".....       |
| Brandon.....  | 49 50.0   | 99 57.0    | 1884   | July 18. . .                | 5-42p            | 14 46.5 "    |
| ".....  | "         | "          | "      | " 19.....                   | 9-02a            | 15 06.8 "    |
| ".....  | "         | "          | "      | " 19.....                   | 11-32a           | 14 47.0 "    |
| ".....  | 49 52.0   | 99 58.0    | 1906 7 | ".....                      | ".....           | 15 00.2 "    |



9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

C. I.—Carnegie Institution.

MANI

| Place.                                      | Latitude. |      | Longitude. |      | Year.  | Month and day. | Hour and minute. | Declination. |        |
|---|-----------|------|------------|------|--------|----------------|------------------|--------------|--------|
|   | °         | '    | °          | '    |        |                |                  | °            | '      |
| Hare island, Cedar lake.....                | 53        | 12·2 | 100        | 00 0 | 1843   |                |                  |              |        |
| Chemahawin, Saskatchewan river.....         | 53        | 20·4 | 100        | 32 2 | 1884   | July 5.....    | 8-00p            | 17           | 36·0 " |
| Devil's Drum island, Saskatchewan R.....    | 53        | 19·5 | 100        | 36·0 | 1843   | Aug. 9.....    | 7-30p            | 17           | 32·2 " |
| " " ".....                                  | "         | "    | "          | "    | "      |                |                  |              |        |
| Lauder.....                                 | 49        | 24·0 | 100        | 43 0 | 1906 7 |                |                  | 16           | 09·5 " |
| On bank of Saskatchewan river Kirkella..... | 53        | 52·6 | 101        | 11·0 | 1884   |                |                  |              |        |
| Round Turn, Saskatchewan river.....         | 50        | 02·0 | 101        | 22·0 | 1906 7 |                |                  | 16           | 02·4 " |
| " " ".....                                  | 53        | 48·8 | 101        | 23·0 | 1844   | Aug. 31.....   | 10-30a           | 19           | 56·8 " |
| " " ".....                                  | "         | "    | "          | "    | "      |                |                  |              |        |
| On bank of Saskatchewan river.....          | 54        | 02·2 | 101        | 34·9 | 1844   | June 22.....   | 7-00p            | 19           | 22 0 " |
| Sturgeon Weir river.....                    | 54        | 20·9 | 101        | 42·9 | 1888   | Oct. 7.....    | 9 50a            | 18           | 27·3 " |
| At Swan River Barracks.....                 | 51        | 54·4 | 101        | 57·3 | 1880   | June 12.....   | 1-00p            | 19           | 37·3 " |
| " " ".....                                  | "         | "    | "          | "    | "      |                |                  |              |        |
| " " ".....                                  | "         | "    | "          | "    | "      |                |                  |              |        |

SESSIONAL PAPER No. 25a

VH—*Con.*

RESULTS—*Con.*

TOBA—*Con.*

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|---------------|
| Aug. 18        | 1-25             | 80 07.1 | Aug. 18        | 2 25             |              | 6484          |              | J. H. Lefroy. |
| July 7         | to 2-19p         | 80 04.4 | July 7         | to 2-48p         |              | 6487          |              | O. Klotz.     |
| Aug. 19        |                  | 80 00.0 | Aug. 19        |                  |              | 6393          |              | J. H. Lefroy. |
|                |                  |         | " 19           |                  |              | 6356          |              | "             |
|                |                  |         | " 19           |                  |              | 6358          |              | "             |
|                |                  | 76 53.7 |                |                  |              | 1433          |              | C. I.         |
| June 28        | 6-08 to 6-50p    | 80 20.2 | June 28        | 6-54 to 7-20p    |              | 6463          | 56           | O. Klotz.     |
|                |                  | 77 17.0 |                |                  |              | 1400          |              | C. I.         |
| Aug. 31        |                  | 80 24.4 | Aug. 31        |                  |              | 6600          |              | J. H. Lefroy. |
|                |                  |         | " 31           |                  |              | 6592          |              | "             |
|                |                  |         | " 31           |                  |              | 6714          |              | "             |
| June 22        | 5-30 to 6-13p    | 80 20.3 | June 22        | 6-20 to 6-50p    |              | 6466          | 81           | O. Klotz.     |
| Oct. 7         | 10-30 to 10-55a  | 80 16.3 | Oct. 7         | 11-27 to 11-45a  |              | 6170          | 60           | Th. Fawcett.  |
| June 12        | 11-15 to 11-50a  | 78 33.4 |                |                  |              |               |              | W. F. King.   |
| June 7 & 8     | 7-30 to 8-15p    | 78 38.4 |                |                  |              |               |              | "             |
|                | 2-00 to 2-30p    |         |                |                  |              |               |              | "             |
| " 13           | 9-45 to 10-30a   |         | 78 36.0        |                  |              |               |              | "             |



SESSIONAL PAPER No. 25a

V111.

RESULTS.

AND ALBERTA.

| Month and day. | Hour and minute.   | Dip.    | Month and day. | Hour and minute.   | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|--------------------|---------|----------------|--------------------|--------------|---------------|-------------|---------------|
| May 23.....    | 11-00<br>to 12-00a | 78 00.5 |                |                    |              |               |             | W. F. King.   |
| " 24.....      | 7-00<br>to 7-45p   | 77 51.6 |                |                    |              |               |             | "             |
| " 27.....      | 5-00<br>to 6-00p   | 77 42.5 |                |                    |              |               |             | "             |
| June 16....    | 7-15<br>to 7 45p   | 78 34.8 |                |                    |              |               |             | "             |
| Aug. 26....    | 2 00<br>to 3-00p   | 80 34.2 | Aug. 26.....   |                    |              | 6501          |             | J. H. Lefroy. |
|                |                    |         | " 26.....      |                    |              | 6421          |             | "             |
|                |                    |         | " 26.....      |                    |              | 6501          |             | "             |
|                |                    |         | " 26.....      |                    |              | 6436          |             | "             |
|                |                    |         | " 26.....      |                    |              | 6408          |             | "             |
|                |                    |         |                |                    |              |               |             | Franklin.     |
| June 28.....   |                    | 80 21.1 |                |                    |              |               |             | "             |
| Aug. 23.....   | 7-00a              | 80 28.2 | Aug. 23.....   |                    |              | 6504          |             | J. H. Lefroy. |
| " 23.....      |                    | 80 31.8 | " 23.....      |                    |              | 6535          |             | "             |
|                |                    |         | " 23.....      |                    |              | 6460          |             | "             |
|                |                    |         | " 24.....      |                    |              | 6532          |             | "             |
|                |                    |         | " 24.....      |                    |              | 6534          |             | "             |
|                |                    |         | " 24.....      |                    |              | 6522          |             | "             |
|                |                    |         | " 24.....      |                    |              | 6519          |             | "             |
|                |                    |         | " 24.....      |                    |              | 6527          |             | "             |
|                |                    |         | " 23.....      |                    |              | 6552          |             | "             |
|                |                    |         | " 23.....      |                    |              | 6551          |             | "             |
|                |                    |         | " 23.....      |                    |              | 6530          |             | "             |
| Aug. 29.....   | p.m.               | 80 20.5 | " 29.....      |                    |              | 6530          |             | "             |
| " 29.....      | p.m.               | 80 19.5 | " 29.....      |                    |              | 6543          |             | "             |
|                |                    |         | " 29.....      |                    |              | 6470          |             | "             |
| June 17.....   | 9-43<br>to 10-29a  | 80 24.3 | June 17.....   | 10-40<br>to 11-05a |              | 6383          | 84          | Otto Klotz.   |
| " 17.....      | 4-07<br>to 4-44p   | 80 28.4 | " 17.....      | 4-48<br>to 5-11p   |              | 6457          | 80          | "             |
| Oct. 14....    | 2-44<br>to 3-10p   | 80 26.4 | Oct. 14.....   | 3-10<br>to 4-00p   |              | 6476          |             | Th. Fawcett.  |
| " 14.....      | 3-12<br>to 3-33p   | 80 21.4 | " 14.....      | 4-00<br>to 4-15p   |              | 6454          |             | "             |
|                |                    | 77 37.5 |                |                    | 1359         |               |             | C. I.         |
| Aug. 27.....   | 1-30p              | 80 39.6 |                |                    |              |               |             | J. H. Lefroy. |
| " 28.....      | 11-00a             | 80 52.7 | Aug. 28.....   |                    |              | 6532          |             | "             |
|                |                    |         | " 28.....      |                    |              | 6473          |             | "             |
|                |                    |         | " 28.....      |                    |              | 6518          |             | "             |
|                |                    |         | " 28.....      |                    |              | 6501          |             | "             |
|                |                    |         | " 28.....      |                    |              | 6465          |             | "             |
|                |                    | 76 18.3 |                |                    | 1490         |               |             | C. I.         |
| June 23....    | 5-00<br>to 5-30p   | 78 21.4 |                |                    |              |               |             | W. F. King.   |
| " 24.....      | 8-30<br>to 9-10p   | 78 21.1 |                |                    |              |               |             | "             |
|                |                    |         |                |                    |              |               |             | "             |
| Sept. 21....   | 2-37<br>to 3-00p   | 81 00.7 | Sept. 21.....  | 3-09<br>to 3-23p   |              | 6451          | 60          | Th. Fawcett.  |
| " 21.....      | 3-44<br>to 4-10p   | 80 59.1 | " 21.....      | 3-25<br>to 3-36p   |              | 6447          | 60          | "             |
| June 8.....    | 5-55<br>to 6-29p   | 79 49.7 | June 8.....    | 6-35<br>to 6-57p   |              | 6474          | 66          | Otto Klotz.   |
| " 26.....      | 0-00<br>to 1-00p   | 78 18.7 |                |                    |              |               |             | W. F. King.   |





SESSIONAL PAPER No. 25a

VIII—Con.

RESULTS—Con.

AND ALBERTA—Con.

| Month and day. | Hour and minute.   | Dip.     | Month and day. | Hour and minute.   | Hor. intens. | Total. intens. | Temperature. | Observer.     |
|----------------|--------------------|----------|----------------|--------------------|--------------|----------------|--------------|---------------|
| June 26.....   | 3-20<br>to 4-15p   | 78 11'4" |                |                    |              |                |              | W. F. King.   |
| " 26.....      | 4-45<br>to 5-25p   | 78 05'7" |                |                    |              |                |              | "             |
| July 5.....    | 6-30<br>to 7-10p   | 77 21'0" |                |                    |              |                |              | "             |
| " 5.....       | 5-45<br>to 6-20p   | 77 25'5" |                |                    |              |                |              | "             |
| June 30.....   | 6-15<br>to 6-30p   | 77 51'6" |                |                    |              |                |              | "             |
| June 29.....   | 11-15<br>to 12-00a | 77 53'2" |                |                    |              |                |              | "             |
| June 2.....    | 3-00<br>to 3-50p   | 79 09'7" | June 2.....    | 4-00<br>to 4-20p   |              | 6544           | 80           | Otto Klotz.   |
| Sept. 15.....  | 0-10<br>to 0-40p   | 80 45'0" | Sept. 15.....  | 9-50<br>to 10-10a  |              | 6408           | 70           | Th. Fawcett.  |
| " 15.....      | 0-45<br>to 1-14p   | 80 45'1" | " 15.....      | 10-10<br>to 10-32a |              | 6408           | 70           | "             |
| " 13.....      | 4-25<br>to 4-37p   | 80 33'4" | " 13.....      | 4-40<br>to 4-58p   |              | 6389           | 55 to 60     | "             |
| " 13.....      | 5-15<br>to 5-30p   | 80 35'3" | " 13.....      | 5-00<br>to 5-13p   |              | 6373           | 55           | "             |
| Aug. 31.....   | 3-30p              | 80 16'4" | Aug. 31.....   |                    |              | 6966           |              | J. H. Lefroy. |
|                |                    |          | " 31.....      |                    |              | 6925           |              | "             |
| July 21.....   | 9-30<br>to 10-50a  | 77 06'2" | July 21.....   | 11-05<br>to 12-00a |              | 6401           | 76           | E. Deville.   |
| " 21.....      | 4-15<br>to 5-05a   | 77 04'0" | " 21.....      | 5-15<br>to 6-15p   |              | 6403           |              | "             |
|                |                    | 76 57'2" |                |                    |              | 1427           |              | "             |
| Sept. 1.....   | 10-00a             | 80 30'9" | Sept. 1.....   |                    |              | 6516           |              | J. H. Lefroy. |
|                |                    |          | " 1.....       |                    |              | 6514           |              | "             |
|                |                    |          | " 1.....       |                    |              | 6460           |              | "             |
|                |                    |          | " 1.....       |                    |              | 6464           |              | "             |
| May 26.....    | 4-05<br>to 5-05p   | 78 59'3" | May 26.....    | 5-30<br>to 6-00p   |              | 6443           | 64           | Otto Klotz.   |
| Aug. 27.....   |                    | 79 11'2" | Aug. 27.....   |                    |              | 6422           |              | J. H. Lefroy. |
|                |                    |          | " 27.....      |                    |              | 6404           |              | "             |
|                |                    |          | " 27.....      |                    |              | 6434           |              | "             |
|                |                    |          |                |                    |              |                |              | H. Y. Hind.   |
| Sept. 7.....   | 4-02<br>to 4-22p   | 80 37'1" | Sept. 7.....   | 4-24<br>to 4-40p   |              | 6422           | 60           | Th. Fawcett.  |
| " 7.....       | 5-00<br>to 5-30p   | 80 38'1" | " 7.....       | 4-42<br>to 4-58p   |              | 6407           | 60           | "             |
| " 2.....       | 10-35<br>to 11-00a | 80 43'2" | " 2.....       | 11-45<br>to 12-00a |              | 6512           | 60           | "             |
| " 2.....       | 11-00<br>to 11-30a | 80 37'1" | " 2.....       | 0-02<br>to 0-18p   |              | 6480           | 60           | "             |
| " 3.....       | 4-30p              | 80 40'3" | " 3.....       |                    |              | 6491           |              | J. H. Lefroy. |
|                |                    |          | " 3.....       |                    |              | 6463           |              | "             |
|                |                    |          | " 3.....       |                    |              | 6450           |              | "             |
| Aug. 26.....   |                    | 78 30'2" | Aug. 26.....   |                    |              | 6350           |              | "             |
| " 26.....      |                    | 78 31'2" | " 26.....      |                    |              | 6366           |              | "             |
|                |                    |          | " 26.....      |                    |              | 6339           |              | "             |
| Aug. 26.....   | 10-30<br>to 10-57a | 80 48'2" | " 26.....      | 11-00<br>to 11-17a |              | 6505           | 70           | Th. Fawcett.  |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC  
SASKATCHEWAN

| Place.                                    | Latitude. | Longitude. | Year. | Month and day. | Hour and minute. | Declination. |
|---|-----------|------------|-------|----------------|------------------|--------------|
| Knee lake.....                            | 55 50 8   | 106 33 4   | 1888  | Aug. 26....    | 2-00p            | 27 53.7 E.   |
| Snake rapid.....                          | 55 44 1   | 106 35 0   | 1843  | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| Near Elbow, South Saskatchewan river..... | 51 01 8   | 106 37 0   | 1880  | July 17....    | 8-00p            | 21 21.0 E.   |
| "   | "         | "          | "     | " 18....       | 6-00p            | 21 17.0 "    |
| Near the N. W. end of Old Wives lake..... | 50 28 9   | 106 46 7   | "     | " 20 ..        | 7-00p            | 21 18.7 "    |
| Narrow Rapids lake.....                   | 55 56 5   | 107 22 1   | 1888  | Aug. 19....    | 1-50p            | 24 03.9 "    |
| "   | "         | "          | "     | "              | "                | "            |
| * Saskatchewan, near Elbow..              | 52 21 4   | 107 23 0   | 1844  | Aug. 24....    | 2-30p            | 25 21.4 E.   |
| Portage Sonnaute .....                    | 55 54 0   | 107 36 0   | 1843  | Sept. 7 ..     | 4-15p            | 26 43.4 "    |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| He à la Crosse .....                      | 55 25 6   | 107 37 0   | 1888  | Aug. 11....    | 3-00p            | 25 02.9 E.   |
| "   | "         | "          | "     | "              | "                | "            |
| South Saskatchewan river....              | 50 39 6   | 107 47 9   | 1884  | "              | "                | "            |
| Fort à la Crosse.....                     | 55 26 8   | 107 54 0   | 1843  | Sept. 9....    | 8-26a            | 24 57.5 E.   |
| "   | "         | "          | "     | " 9....        | 8-54a            | 24 35.0 "    |
| "   | "         | "          | "     | " 9....        | 5-30p            | 25 11.7 "    |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | 1819  | February...    | "                | 22 15.8 E.   |
| "   | "         | "          | 1825  | June 27....    | "                | 23 19.3 "    |
| Narrows of Buffalo lake .....             | 55 37 9   | 108 13 5   | 1888  | Aug. 5....     | 0-50p            | 25 15.9 "    |
| "   | "         | "          | "     | "              | "                | "            |
| Battleford.....                           | 52 42 7   | 108 18 8   | 1880  | "              | "                | "            |
| "   | "         | "          | 1884  | July 28....    | 10-00a           | 22 12.7 E.   |
| "   | "         | "          | "     | " 28....       | 3-00p            | 21 57.2 "    |
| "   | "         | "          | "     | " 28....       | 6-00p            | 21 59.9 "    |
| "   | "         | "          | "     | " 29....       | 7-40a            | 22 15.4 "    |
| "   | "         | "          | "     | " 29....       | 9-10a            | 22 06.2 "    |
| "   | "         | "          | "     | " 29....       | 0-35p            | 21 58.2 "    |
| * Willow hills .....                      | 53 00 1   | 108 30 0   | 1844  | Aug. 23....    | p.m.             | 28 24.1 "    |
| "   | "         | "          | "     | "              | "                | "            |
| Northern end of Buffalo lake..            | 56 04 0   | 108 40 0   | 1843  | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| "   | "         | "          | "     | "              | "                | "            |
| Sidewood, on Cypress trail .....          | 50 02 6   | 108 51 4   | 1880  | July 24....    | 7-00p            | 22 00.0 E.   |

\* Local disturbance.

SESSIONAL PAPER No. 25a

VIII—Con.

RESULTS—Con

AND ALBERTA—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
| Aug. 26...     | 11 20 to 11-43a  | 80 45 8 | Aug. 26....    | 11-48 to 12-06a  |              | 6529          | 65          | Th. Fawcett.  |
| Sept. 4....    | 1-30p            | 80 38 8 | Sept. 4....    |                  |              | 6537          |             | J. H. Lefroy. |
|                |                  |         | " 4....        |                  |              | 6505          |             | "             |
|                |                  |         | " 4....        |                  |              | 6477          |             | "             |
| July 18....    | 7-20 to 7-50p    | 77 05 5 |                |                  |              |               |             | W. F. King.   |
| " 18....       | 6-50 to 7-30p    | 77 02 3 |                |                  |              |               |             | "             |
| " 20....       | 5-50 to 6-35p    | 76 51 3 |                |                  |              |               |             | "             |
| Aug. 19....    | 2-30 to 3-00p    | 80 39 8 | Aug. 19....    | 3-00 to 3-30p    |              | 6419          | 76          | Th. Fawcett.  |
| " 19....       | 3-35 to 4-00p    | 80 34 2 | " 19....       | 5-15 to 5-40p    |              | 6426          | 73          | "             |
| " 24....       | p. m.            | 78 16 6 | " 24....       |                  |              | 6495          |             | J. H. Lefroy. |
| Sept. 7....    |                  | 80 11 2 | Sept. 7....    |                  |              | 6481          |             | "             |
|                |                  |         | " 7....        |                  |              | 6482          |             | "             |
|                |                  |         | " 7....        |                  |              | 6438          |             | "             |
|                |                  |         | " 7....        |                  |              | 6499          |             | "             |
| Aug. 11....    | 5-45 to 6-35     | 79 56 1 | Aug. 11....    | 4-15 to 4-35p    |              | 6371          | 75          | Th. Fawcett.  |
| " 11....       | 4-00 to 5-30p    | 79 58 1 | " 11....       | 6-40 to 7-04p    |              | 6371          | 66          | "             |
| May 8....      | 6-30 to 7-30     | 76 32 5 | May 8....      | 5-35 to 6-30p    |              | 6132          | 58          | Otto Klotz.   |
| Sept. 9....    |                  | 80 09 1 | Sept. 9....    |                  |              | 6476          |             | J. H. Lefroy. |
| " 9....        |                  | 80 10 5 | " 9....        |                  |              | 6471          |             | "             |
|                |                  |         | " 9....        |                  |              | 6454          |             | "             |
|                |                  |         | " 9....        |                  |              | 6449          |             | "             |
|                |                  |         | " 9....        |                  |              | 6442          |             | "             |
|                |                  |         | " 9....        |                  |              | 6442          |             | "             |
|                |                  |         | " 9....        |                  |              | 6440          |             | "             |
|                |                  |         | " 9....        |                  |              | 6469          |             | "             |
|                |                  |         | " 9....        |                  |              | 6442          |             | "             |
|                |                  |         | " 9....        |                  |              | 6439          |             | "             |
| July 11....    |                  | 79 55 0 |                |                  |              |               |             | J. Franklin.  |
| Aug. 5....     | 1-40 to 2-06p    | 80 11 9 | Aug. 5....     | 2-13 to 2-36p    |              | 6427          | 68          | Th. Fawcett.  |
| " 5....        | 2-42 to 3-08p    | 80 13 3 | " 5....        | 3-10 to 3-35p    |              | 6429          | 60          | "             |
| Nov. 1....     | 9-45 to 10-10a   | 77 52 3 |                |                  |              |               |             | W. F. King.   |
| " 2....        | 11-15 to 11-40a  | 77 46 4 |                |                  |              |               |             | "             |
|                |                  |         |                |                  |              |               |             | E. Deville.   |
|                |                  |         |                |                  |              |               |             | "             |
|                |                  |         |                |                  |              |               |             | "             |
| Aug. 23....    | p.m.             | 78 28 1 | Aug. 23....    |                  |              | 6569          |             | J. H. Lefroy. |
|                |                  |         | " 23....       |                  |              | 6548          |             | "             |
|                |                  |         | " 23....       |                  |              | 6585          |             | "             |
| Sept. 13....   | 7-00a            | 89 37 0 | Sept. 13....   |                  |              | 6422          |             | "             |
|                |                  |         | " 13....       |                  |              | 6470          |             | "             |
|                |                  |         | " 13....       |                  |              | 6457          |             | "             |
|                |                  |         | " 13....       |                  |              | 6420          |             | "             |
| July 25....    | 1-20 to 1-55p    | 75 50 1 |                |                  |              |               |             | W. F. King.   |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC  
SASKATCHEWAN

| Place.  | Latitude. | Longitude. | Year. | Month and day.     | Hour and minute. | Declination. |
|---|-----------|------------|-------|--------------------|------------------|--------------|
| River La Loche . . . . .                              | 56 11.6   | 108 57.5   | 1888  | July 29...         | 2-10p            | 28 10.0 E.   |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| La Loche lake . . . . .                               | 56 26.6   | 109 12.8   | 1888  | July 22 ..         | 2-10p            | 25 49.0 E.   |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| North end of Long portage . . . . .                   | 56 14.7   | 109 18.0   | 1843  | Sept. 14 . . . . . | 9-35a            | 28 40.6 E.   |
| " . . . . .   | "         | "          | "     | " 14 . . . . .     | 9-43a            | 28 27.5 "    |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Portage La Loche . . . . .                            | 56 35.2   | 109 30.2   | 1888  | July 18 . . . . .  | 10-00a           | 26 37.3 E.   |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Great Methye portage . . . . .                        | 56 35.0   | 109 37.0   | 1843  | Sept. 16 . . . . . | 8-38a            | 26 15.0 E.   |
| " . . . . .   | "         | "          | "     | " 16 . . . . .     | 9-30a            | 26 59.7 "    |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Fort Pitt . . . . .                                   | 53 34.1   | 109 47.2   | 1844  | Aug. 22 . . . . .  | 6-50a            | 23 07.3 E.   |
| " . . . . .   | "         | "          | "     | " 22 . . . . .     | 7-57a            | 23 11.2 "    |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| At the gap of Cypress hills . . . . .                 | 49 37.7   | 109 51.4   | 1880  | July 31 . . . . .  | 7-00p            | 21 43.7 E.   |
| Great Methye ptge, N.W. end . . . . .                 | 56 43.7   | 109 52.3   | 1820  | " . . . . .        | "                | 25 02.5 "    |
| " . . . . .   | "         | "          | 1843  | Sept. 17 . . . . . | 7-00a            | 28 30.3 "    |
| " . . . . .   | "         | "          | "     | " 17 . . . . .     | 7-22a            | 28 25.0 "    |
| " . . . . .   | "         | "          | "     | " 17 . . . . .     | 7-30a            | 28 30.6 "    |
| Clear Water river . . . . .                           | 56 42.7   | 110 03.9   | 1888  | July 8 . . . . .   | 10-00a           | 26 53.5 "    |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Land survey station . . . . .                         | 51 05.0   | 110 15.0   | 1882  | " . . . . .        | "                | "            |
| Clear Water river . . . . .                           | 56 39.4   | 110 46.6   | 1888  | July 1 . . . . .   | 10-40a           | 28 54.3 E.   |
| " . . . . .   | "         | "          | "     | " 1 . . . . .      | 2-00p            | 28 56.9 "    |
| Two miles below mouth of<br>Pembina river . . . . .   | 59 39.0   | 110 55.0   | 1843  | " . . . . .        | "                | "            |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Saskatchewan river near<br>Moose Hill creek . . . . . | 53 50.0   | 110 59.0   | 1844  | Aug. 21 . . . . .  | 8-08a            | 24 26.6 E.   |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Fort McMurray . . . . .                               | 56 43.9   | 111 13.6   | 1888  | June 23 . . . . .  | 9-00a            | 29 02.4 E.   |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| Fort Chipewyan, L. Athabaska . . . . .                | 58 43.0   | 111 18.7   | 1843  | Sept. 23 . . . . . | 3-50p            | 28 09.1 E.   |
| " . . . . .   | "         | "          | "     | " 23 . . . . .     | 3-59p            | 27 08.4 "    |
| " . . . . .   | "         | "          | "     | Oct. 16 . . . . .  | "                | 28 30.8 "    |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| " . . . . .   | "         | "          | "     | "                  | "                | "            |
| " . . . . .   | "         | "          | 1820  | March . . . . .    | "                | 22 49.6 E.   |
| " . . . . .   | "         | "          | 1825  | July 11 . . . . .  | "                | 25 29.0 "    |
| " . . . . .   | "         | "          | 1843  | "                  | "                | "            |

SESSIONAL PAPER No. 25a

VIII—*Con.*

RESULTS—*Con.*

AND ALBERTA—*Con.*

| Month and day. | Hour and minute.   | Dip.    | Month and day. | Hour and minute.   | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|--------------------|---------|----------------|--------------------|--------------|---------------|-------------|---------------|
| July 29...     | to 3-00<br>3-22p   | 80 34 0 | July 29....    | to 3-24<br>3-43p   | .....        | 6456          | 61          | Th. Fawcett.  |
| " 29....       | to 3-45<br>4-20p   | 80 33 1 | " 29....       | to 4-25<br>4-45p   | .....        | 6435          | 59          | "             |
| " 22....       | to 2-45<br>3-20p   | 80 31 9 | " 22....       | to 4-32<br>5-02p   | .....        | 6409          | 76          | "             |
| " 22....       | to 3-47<br>4-25p   | 80 35 5 | " 22....       | to 3-22<br>3-45p   | .....        | 6352          | 86          | "             |
| Sept. 14....   | 10-15a             | 80 19 7 | Sept. 14....   | .....              | .....        | 6380          | .....       | J. H. Lefroy. |
| .....          | .....              | .....   | " 14....       | .....              | .....        | 6425          | .....       | "             |
| .....          | .....              | .....   | " 14....       | .....              | .....        | 6401          | .....       | "             |
| .....          | .....              | .....   | " 14....       | .....              | .....        | 6432          | .....       | "             |
| July 18....    | 10-40<br>to 11-10a | 80 29 3 | July 18....    | 11-14<br>to 11-35a | .....        | 6397          | 88          | Th. Fawcett.  |
| " 18....       | 11-45a<br>to 0-13p | 80 28 3 | " 18....       | 0-15<br>to 0-40p   | .....        | 6417          | 81          | "             |
| Sept. 16....   | 9-60a              | 80 36 4 | Sept. 16....   | .....              | .....        | 6444          | .....       | J. H. Lefroy. |
| .....          | .....              | .....   | " 16....       | .....              | .....        | 6457          | .....       | "             |
| .....          | .....              | .....   | " 16....       | .....              | .....        | 6426          | .....       | "             |
| .....          | .....              | .....   | " 16....       | .....              | .....        | 6467          | .....       | "             |
| Aug. 22....    | a. m.              | 78 43 0 | Aug. 22....    | .....              | .....        | 6533          | .....       | "             |
| " 22....       | "                  | 78 39 1 | " 22....       | .....              | .....        | 6520          | .....       | "             |
| .....          | .....              | .....   | " 22....       | .....              | .....        | 6526          | .....       | "             |
| July 28....    | 0-15<br>to 0-45p   | 75 20 4 | .....          | .....              | .....        | .....         | .....       | W. F. King.   |
| Sept. 17....   | 6-00a              | 80 38 3 | .....          | .....              | .....        | .....         | .....       | Franklin.     |
| .....          | .....              | .....   | .....          | .....              | .....        | .....         | .....       | J. H. Lefroy. |
| .....          | .....              | .....   | .....          | .....              | .....        | .....         | .....       | "             |
| .....          | .....              | .....   | .....          | .....              | .....        | .....         | .....       | "             |
| July 8....     | 11-15<br>to 11-45a | 80 27 4 | July 8....     | 11-50a<br>to 0-15p | .....        | 6377          | 76          | Th. Fawcett.  |
| " 8....        | 0-20<br>to 0-50p   | 80 25 5 | " 8....        | 0-55<br>to 1-20p   | .....        | 6425          | 65          | "             |
| " 15....       | .....              | 76 14 1 | .....          | .....              | .....        | .....         | .....       | Wm. Ogilvie.  |
| " 1....        | 11-10<br>to 11-40a | 80 09 1 | July 1....     | 11-40<br>to 12-00a | .....        | 6419          | 66          | Th. Fawcett.  |
| " 1....        | 3-40<br>to 4-00p   | 80 12 1 | " 1....        | 4-04<br>to 4-50p   | .....        | 6460          | 68          | "             |
| Sept. 19....   | 8 30a              | 80 36 2 | Sept. 19....   | .....              | .....        | 6456          | .....       | J. H. Lefroy. |
| .....          | .....              | .....   | " 19....       | .....              | .....        | 6414          | .....       | "             |
| .....          | .....              | .....   | " 19....       | .....              | .....        | 6364          | .....       | "             |
| .....          | .....              | .....   | " 19....       | .....              | .....        | 6419          | .....       | "             |
| Aug. 21....    | .....              | 78 33 5 | Aug. 21....    | .....              | .....        | 6410          | .....       | "             |
| .....          | .....              | .....   | " 21....       | .....              | .....        | 6350          | .....       | "             |
| .....          | .....              | .....   | " 21....       | .....              | .....        | 6391          | .....       | "             |
| June 23....    | 9-30<br>to 10-00a  | 80 07 8 | June 23....    | 10-04<br>to 10-35a | .....        | 6334          | 57          | Th. Fawcett.  |
| " 23....       | 10-40<br>to 11-04a | 80 09 8 | " 23....       | 11-04<br>to 11-30a | .....        | 6371          | 59          | "             |
| Sept. 30....   | 9-00a              | 81 37 7 | Sept. 25....   | .....              | .....        | 6374          | .....       | J. H. Lefroy. |
| " 30....       | 11-00a             | 81 37 5 | " 25....       | .....              | .....        | 6413          | .....       | "             |
| .....          | .....              | .....   | Oct. 9....     | .....              | .....        | 6383          | .....       | "             |
| .....          | .....              | .....   | Sept. 30....   | .....              | .....        | 6449          | .....       | "             |
| .....          | .....              | .....   | Oct. 6....     | .....              | .....        | 6446          | .....       | "             |
| .....          | .....              | .....   | Oct. 10....    | .....              | .....        | 6456          | .....       | "             |
| .....          | .....              | .....   | .....          | .....              | .....        | .....         | .....       | J. Franklin.  |
| July 24....    | .....              | 81 26 1 | .....          | .....              | .....        | .....         | .....       | "             |
| .....          | .....              | .....   | Oct. 13....    | .....              | .....        | 6419          | .....       | J. H. Lefroy. |

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TABLE

MAGNETIC

SASKATCHEWAN

| Place.                              | Latitude. | Longitude. | Year. | Month.<br>and<br>day. | Hour<br>and<br>minute. | Declination. |
|-------------------------------------|-----------|------------|-------|-----------------------|------------------------|--------------|
| Fort Chipewyan, L. Athabaska        | 58 48 0   | 111 18 7   | 1843  |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | 1844  |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     | July 2                | 9-34a                  | 29 52 0 E.   |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | 1884  |                       |                        |              |
| " " "                               | " "       | " "        | 1888  | Nov. 22               | 3-20p                  | 27 15 3 E.   |
| " " "                               | " "       | " "        | "     | " 23                  | 3-30p                  | 27 09 5 "    |
| " " "                               | " "       | " "        | "     | " 24                  | 10-15a                 | 27 17 9 "    |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| In the valley of Vermilion<br>river | 53 35 9   | 111 24 0   | 1886  | Oct. 17               | 10-30a                 | 25 46 4 E.   |
| Point Brule, Athabaska river        | 58 07 0   | 111 25 0   | 1843  |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| *Pierre au Calumet                  | 57 24 0   | 111 35 0   | "     | Sept. 20              | 5-03p                  | 26 35 1 E.   |
| " " "                               | " "       | " "        | "     | " 20                  | 5-15p                  | 25 24 9 "    |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| Land survey station                 | 51 00 5   | 111 40 5   | 1882  |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| Pelican portage                     | 59 58 0   | 111 51 0   | 1844  | June 27               | 6-24p                  | 36 15 0 E.   |
| Point Providence                    | 58 58 0   | 112 10 0   | "     | July 5                | 3-11p                  | 30 35 0 "    |
| On Saskatchewan river               | 54 04 5   | 112 19 5   | "     | Aug. 20               | 9 20a                  | 23 55 0 "    |
| " " "                               | " "       | " "        | "     | " 20                  | 9-33a                  | 24 56 0 "    |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| On Peace river                      | 58 58 0   | 112 56 1   | "     | July 7                | 7-19a                  | 32 24 0 E.   |
| Willow creek                        | 49 45 3   | 113 24 0   | 1880  | Aug. 17               | 6-00p                  | 22 32 0 "    |
| " " "                               | " "       | " "        | "     | " 18                  | 9-00a                  | 22 43 0 "    |
| " " "                               | " "       | " "        | "     | " 18                  | 9-10a                  | 22 39 0 "    |
| Athabaska river                     | 54 51 0   | 113 25 0   | 1888  | May 27                | 4-00p                  | 24 33 3 E.   |
| " " "                               | " "       | " "        | "     | " 28                  | 6-50a                  | 24 16 4 "    |
| Fort Edmonton                       | 53 32 0   | 113 30 1   | 1844  | Aug. 16               | 7-31a                  | 23 47 0 "    |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | "     |                       |                        |              |
| " " "                               | " "       | " "        | 1880  | Oct. 6                | 2-00p                  | 26 43 2 "    |
| " " "                               | " "       | " "        | "     |                       |                        |              |

\*Local disturbance.

SESSIONAL PAPER No. 25a

VIII—Con.

RESULTS—Con.

AND ALBERTA—Con.

| Month and day. | Hour and minute.   | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|--------------------|---------|----------------|------------------|--------------|---------------|-------------|---------------|
|                |                    |         | Oct. 13        |                  |              | 6399          |             | J. H. Lefroy. |
|                |                    |         | " 13           |                  |              | 6428          |             | "             |
|                |                    |         | " 13           |                  |              | 6418          |             | "             |
|                |                    |         | " 13           |                  |              | 6411          |             | "             |
|                |                    |         | " 14           |                  |              | 6386          |             | "             |
|                |                    |         | " 14           |                  |              | 6453          |             | "             |
|                |                    |         | " 14           |                  |              | 6425          |             | "             |
|                |                    |         | Mar. 1         |                  |              | 6384          |             | "             |
|                |                    |         | " 1            |                  |              | 6363          |             | "             |
|                |                    |         | " 1            |                  |              | 6331          |             | "             |
|                |                    |         | " 1            |                  |              | 6368          |             | "             |
| Feb. 27        | 1-04p              | 81 35.4 | July 2         |                  |              | 6431          |             | "             |
|                |                    |         | " 2            |                  |              | 6433          |             | "             |
|                |                    |         | " 2            |                  |              | 6426          |             | "             |
| Sept. 17       |                    | 81 26.6 |                |                  |              |               |             | H. P. Dawson. |
| Nov. 22        | 1-50<br>to 2-21p   | 81 22.2 | Nov. 22        | 2-25<br>to 2-45p |              | 6335          | 17.5        | Wm. Ogilvie.  |
| " 22           | 3-06<br>to 3-24p   | 81 21.4 | " 22           | 2-48<br>to 3-04p |              | 6306          | 17.5        | "             |
| " 23           | 1-45<br>to 2-07p   | 81 23.3 | " 23           | 2-05<br>to 2-20p |              | 6348          | 18          | "             |
| " 23           | 3-05<br>to 3-25p   | 81 21.7 | " 23           | 2-40<br>to 3-01p |              | 6355          | 16          | "             |
| Oct. 17        | 2-45<br>to 3-05p   | 77 56.8 |                |                  |              |               |             | W. F. King.   |
| Sept. 21       | 4-00p              | 81 30.6 | Sept. 21       |                  |              | 6402          |             | J. H. Lefroy. |
|                |                    |         | " 21           |                  |              | 6475          |             | "             |
|                |                    |         | " 21           |                  |              | 6438          |             | "             |
|                |                    |         | " 21           |                  |              | 6493          |             | "             |
| Sept. 20       | 2-30p              | 81 16.8 | Sept. 20       |                  |              | 6739          |             | "             |
|                |                    |         | " 20           |                  |              | 6615          |             | "             |
|                |                    |         | " 20           |                  |              | 6597          |             | "             |
|                |                    |         | " 20           |                  |              | 6631          |             | "             |
| Aug. 6         |                    | 76 16.5 |                |                  |              |               |             | Wm. Ogilvie.  |
| " 6            |                    | 76 09.7 |                |                  |              |               |             | "             |
| June 27        |                    | 82 26.8 |                |                  |              |               |             | J. H. Lefroy. |
| July 5         |                    | 81 46.1 |                |                  |              |               |             | "             |
| Aug. 20        |                    | 78 05.2 | Aug. 20        |                  |              | 6330          |             | "             |
|                |                    |         | " 20           |                  |              | 6311          |             | "             |
|                |                    |         | " 20           |                  |              | 6316          |             | "             |
| July 7         |                    | 81 36.9 |                |                  |              |               |             | "             |
| Aug. 17        | 3-50<br>to 4-20p   | 74 44.8 |                |                  |              |               |             | W. F. King.   |
| " 17           | 5-25<br>to 5-40p   | 74 47.9 |                |                  |              |               |             | "             |
|                |                    |         |                |                  |              |               |             | "             |
| May 27         | 4-26<br>to 5-05p   | 78 08.3 | May 27         | 5-07<br>to 5-40p |              | 6351          | 70          | Th. Fawcett.  |
| " 28           | 7-35<br>to 8-28a   | 78 07.2 | " 28           | 7-40<br>to 8-28a |              | 6415          | 51          | "             |
| Aug. 17        |                    | 77 53.4 | Aug. 17        |                  |              | 6476          |             | J. H. Lefroy. |
| " 17           |                    | 77 55.1 | " 17           |                  |              | 6418          |             | "             |
|                |                    |         | " 17           |                  |              | 6474          |             | "             |
|                |                    |         | " 17           |                  |              | 6499          |             | "             |
|                |                    |         | " 17           |                  |              | 6468          |             | "             |
| Oct. 6         | 4-40<br>to 5-00p   | 77 31.6 |                |                  |              |               |             | W. F. King.   |
| " 7            | 10-20<br>to 10-40a | 77 29.4 |                |                  |              |               |             | "             |

9-10 EDWARD VII., A. 1910

TABLE

MAGNETIC

C. 1.—Carnegie Institution.

SASKATCHEWAN

| Place.                                      | Latitude. | Longitude. | Year.  | Month and day. | Hour and minute. | Declination. |
|---|-----------|------------|--------|----------------|------------------|--------------|
| Fort Edmonton.....                          | 53 32·0   | 113 30·1   | 1888   | May 17 .....   | 1-30p            | 25 28·7 E    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| At north branch, Pipestone creek.....       | 53 04·3   | 113 35 5   | 1880   | Sept. 25....   | 6-00p            | 25 14·4 "    |
| Mosquito creek.....                         | 50 22·4   | 113 48·8   | "      | Aug. 20 .....  | 7-00p            | 22 03·0 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Forks of the Athabaska.....                 | 55 13·0   | 113 53·2   | 1844   | Aug 7. ....    | 4-44p            | 26 28·0 "    |
| Fourth base on 5 <sup>th</sup> meridian.... | 50 02·9   | 114 00·0   | 1887   | July 19. ....  | 1-50p            | 23 53·7 "    |
| Land survey station .....                   | 54 21·3   | 114 00 0   | 1883   | .....          | .....            | .....        |
| Athabaska river.....                        | 54 43·0   | 114 00 2   | 1844   | Aug. 9 .....   | 9-10a            | 26 29·1 "    |
| Crossing of Pembina river.....              | 54 03·2   | 114 00·2   | "      | " 14.....      | 9-42a            | 22 23·0 "    |
| Mouth of Lesser Slave lake....              | 55 29·0   | 114 03·5   | 1888   | June 4.....    | noon.            | 27 22·5 "    |
| " .....                                     | "         | "          | "      | " 4.....       | 3-15p            | 27 25·3 "    |
| Land survey station.....                    | 55 10 0   | 114 03 5   | 1883   | May 9 .....    | .....            | 27 45·4 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Near Fort Calgary.....                      | 51 03 0   | 114 04·0   | 1880   | .....          | .....            | .....        |
| Poplar island.....                          | 58 39·0   | 114 10·7   | 1844   | July 9 .....   | 9-30a            | 26 29·8 "    |
| Morleyville, Rocky Mt.....                  | 51 10 5   | 114 18·5   | 1880   | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Fort Assiniboine.....                       | 54 21·7   | 114 28·4   | 1844   | Aug. 11.....   | 7-02a            | 24 39·0 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Falls of the Peace river.....               | 58 24·2   | 114 51·1   | "      | July 10.....   | 10-38a           | 30 22·0 "    |
| Swan point, Lesser Slave lake..             | 55 26·0   | 115 03·1   | "      | Aug. 6.....    | 10-00a           | 26 19·0 "    |
| Sulphur mountain.....                       | 51 09·0   | 115 34·0   | 1907·5 | .....          | .....            | 25 53·5 "    |
| Banff .....                                 | "         | "          | "      | .....          | .....            | 25 59·3 "    |
| Tunnel mountain .....                       | 51 11·0   | "          | "      | .....          | .....            | 25 57·4 "    |
| Banff (C.I.S.).....                         | 51 10·0   | 115 37·0   | 1908   | July 22-24..   | .....            | 26 5·6 "     |
| Fort Vermilion.....                         | 58 24·5   | 115 58·6   | 1844   | July 11.....   | 6-31p            | 32 40·0 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Fort of Lesser Slave lake.....              | 58 32·6   | 116 00·0   | "      | Aug. 3 .....   | 5-37p            | 26 52·5 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Land survey station.....                    | 55 32·5   | 116 08·6   | 1883   | .....          | .....            | .....        |
| On Peace river.....                         | 57 19·0   | 117 01·7   | 1844   | July 17. ....  | 8-39a            | 28 53·0 "    |
| Opposite River Cadotte.....                 | 56 47·0   | 117 01·7   | "      | " 19.....      | 9-17a            | 27 03·0 "    |
| Island opposite Baril river.....            | 57 57·0   | 117 04·7   | "      | " 15.....      | 8-22a            | 29 56·0 "    |
| Land survey station.....                    | 56 08·0   | 117 50 6   | 1883   | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| Fort Dunvegan.....                          | 55 55·6   | 118 28·5   | 1844   | July 23.....   | 10-05a           | 27 09·0 "    |
| " .....                                     | "         | "          | "      | " 25.....      | 5-49p            | 27 24·0 "    |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |
| " .....                                     | "         | "          | "      | .....          | .....            | .....        |



SESSIONAL PAPER No. 25a

VIII—Con.

RESULTS—Con.

AND ALBERTA—Con.

| Month and day. | Hour and minute. | Dip.      | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|------------------|-----------|----------------|------------------|--------------|---------------|-------------|---------------|
| May 17.....    | 1-50<br>to 3-05p | 77 30.4   | May 17.....    | 4-11<br>to 5-00p |              | 6391          |             | Th. Fawcett.  |
| " 17.....      | 3-21<br>to 3-53p | 77 30.9   |                |                  |              |               |             | "             |
| Sept. 26...    | 6-30<br>to 6-50a | 77 03.2   |                |                  |              |               |             | W. F. King.   |
| Aug. 20...     | 5-45<br>to 6-10p | 74 40.1   |                |                  |              |               |             | "             |
| " 21.....      | 6-15<br>to 6-30a | 74 48.2   |                |                  |              |               |             | "             |
| Aug. 7.....    |                  | 78 55.2   |                |                  |              |               |             | J. H. Lefroy. |
| July 19.....   |                  | 74 37.5   |                |                  |              |               |             | J. S. Dennis. |
| Jan. 1.....    |                  | 77 58.1   |                |                  |              |               |             | Wm. Ogilvie.  |
| Aug. 9.....    |                  | 78 34.1   |                |                  |              |               |             | J. H. Lefroy. |
| " 14.....      |                  | 77 54.0   |                |                  |              |               |             | "             |
| June 4.....    | 1-00<br>to 1-30p | 78 31.7   | June 4.....    | 1-38<br>to 2-05p |              | 6308          |             | Th. Fawcett.  |
| " 4.....       | 1-38<br>to 2-40p | 78 33.3   | " 4.....       | 2-07<br>to 2-40p |              | 6323          |             | "             |
| May 10.....    |                  | 78 24.1   |                |                  |              |               |             | Wm. Ogilvie.  |
| " 11.....      |                  | 78 28.2   |                |                  |              |               |             | "             |
| " 11.....      |                  | 78 29.9   |                |                  |              |               |             | "             |
| Sept. 11....   | 1-00<br>to 1-20p | 75 23.4   |                |                  |              |               |             | W. F. King.   |
| July 9.....    |                  | 81 04.8   |                |                  |              |               |             | J. H. Lefroy. |
| Sept. 16....   | 0-25<br>to 0-45p | 75 14.3   |                |                  |              |               |             | W. F. King.   |
| " 16.....      | 3-00<br>to 3-15p | 75 19.7   |                |                  |              |               |             | "             |
| Aug. 11....    |                  | 78 16.9   |                |                  |              |               |             | J. H. Lefroy. |
| " 11.....      |                  | 78 13.5   |                |                  |              |               |             | "             |
| July 10....    |                  | 80 50.8   |                |                  |              |               |             | "             |
| Aug. 6.....    |                  | 78 29.9   |                |                  |              |               |             | "             |
|                |                  | 74 54.0   |                |                  | 1590         |               |             | C.I.          |
|                |                  | 74 56.3   |                |                  | 1593         |               |             | C.I.          |
|                |                  | 74 57.6   |                |                  | 1593         |               |             | C.I.          |
| July 23, 24..  |                  | 74 58.1   | July 22, 24..  |                  | 15955        |               |             | C. A. French. |
| July 11.....   |                  | 80 48.4   | July 11.....   |                  |              | 6505          |             | J. H. Lefroy. |
| " 11.....      |                  | 80 47.6   | " 11.....      |                  |              | 6409          |             | "             |
|                |                  |           | " 11.....      |                  |              | 6472          |             | "             |
|                |                  |           | " 11.....      |                  |              | 6515          |             | "             |
|                |                  |           | " 11.....      |                  |              | 6463          |             | "             |
| Aug. 3.....    |                  | 78 36.2   | Aug. 5.....    |                  |              | 6422          |             | "             |
| " 3.....       |                  | 78 41.8   | " 5.....       |                  |              | 6397          |             | "             |
|                |                  |           | " 5.....       |                  |              | 6369          |             | "             |
| Oct. 3.....    |                  | (78 18.1) |                |                  |              |               |             | Wm. Ogilvie.  |
|                |                  | (78 12.4) |                |                  |              |               |             | "             |
| July 17.....   |                  | 79 27.0   |                |                  |              |               |             | J. H. Lefroy. |
| " 19.....      |                  | 79 20.7   |                |                  |              |               |             | "             |
| " 15.....      |                  | 80 00.7   |                |                  |              |               |             | "             |
| Sept. 22.....  |                  | 78 14.3   |                |                  |              |               |             | Wm. Ogilvie.  |
| " 22.....      |                  | 78 20.2   |                |                  |              |               |             | "             |
| July 22.....   |                  | 78 45.7   | July 23.....   |                  |              | 6477          |             | J. H. Lefroy. |
| " 22.....      |                  | 78 46.8   | " 23.....      |                  |              | 6439          |             | "             |
|                |                  |           | " 23.....      |                  |              | 6445          |             | "             |
|                |                  |           | " 23.....      |                  |              | 6452          |             | "             |
|                |                  |           | " 23.....      |                  |              | 6452          |             | "             |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

C. I. —Carnegie Institution.

BRITISH

| Place.  | Latitude. | Longitude. | Year.  | Month<br>and day.        | Hour<br>and<br>minute. | Declination. |
|---|-----------|------------|--------|--------------------------|------------------------|--------------|
| Akamina station.....  | 49 01'0   | 114 04'0   | 1861   | Aug. 2.....              |                        | 23 12'0 E    |
| *Wigwam river section.....  | 49 00'0   | 114 45'0   | "      | July 15, Aug.<br>14..... |                        | 23 52'0 "    |
| Camp No. 11.....  | 49 07'0   | 115 16'0   | "      |                          |                        |              |
| Joseph's prairie, Camp No. 14.  | 49 31'0   | 115 35'0   | "      |                          |                        |              |
| Stephen, Rocky mountains ...  | 51 27'0   | 116 17'7   | 1886   | May 14.....              | 4-00p                  | 23 55'0 "    |
| Near Leancoil, along C.P.R.<br>Between Palliser and Golden,<br>C.P.R..... | 51 13'8   | 116 37'9   | "      | " 28.....                | 4-45p                  | 23 33'0 "    |
| Golden.....   | 51 17'9   | 116 51'7   | "      | June 4.....              | 11-00a                 | 25 40'0 "    |
| ".....  | 51 18'0   | 116 57'0   | 1908   | July 27-30.....          |                        | 26 03'5      |
| One mile north of Golden.....   | 51 18'8   | 116 58'5   | 1886   | June 9.....              | 5-54p                  | 25 37'0 E    |
| Keefe and Clarke siding.....  | 51 30'9   | 117 20'4   | "      | " 18 ..                  | 9-21a                  | 26 34'0 "    |
| Glacier.....  | 51 16'0   | 117 28'0   | 1907-8 |                          |                        | 25 57'1 "    |
| Near Rogers pass, along C.P.R.  | 51 17'6   | 117 31'0   | 1886   | June 30.....             | 2-45p                  | 25 27'5 "    |
| Near Revelstoke, along C.P.R.<br>Revelstoke.....                          | 51 00'1   | 118 11'9   | "      | Aug. 15.....             | 4-23p                  | 27 17'5 "    |
| ".....  | 51 00'0   | 118 12'0   | 1908   | Aug. 3, 4, 5.....        |                        | 25 48'6      |
| Inchwointum station.....  | 49 00'0   | 118 28'0   | 1860   | Nov. 13.....             |                        | 20 17'0      |
| Sicamous.....   | 50 50'0   | 118 59'0   | 1908   | Aug. 6-10.....           |                        | 25 52'8      |
| Sicamous narrows.....   | 50 49'7   | 118 59'6   | 1885   | Oct. 21.....             | 11-20a                 | 24 46'2 "    |
| ".....  | "         | "          | "      |                          |                        |              |
| 120 yds. west of station 1569 of<br>traverse.....                         | 50 44'7   | 119 14'5   | "      | " 4 ..                   | 4-50p                  | 24 37'5 "    |
| ".....  | "         | "          | "      |                          |                        |              |
| Lake Shuswap, Blind bay.....  | 50 51'0   | 119 19'5   | "      |                          |                        |              |
| ".....  | "         | "          | "      |                          |                        |              |
| Southwest end of Salmon Arm,<br>Lake Shuswap.....                         | 50 45'9   | 119 19'9   | "      | Sept. 25....             | 5-10p                  | 24 55'9 E    |
| ".....  | "         | "          | "      | " 27.....                | 5-15p                  | 24 46'9 "    |
| ".....  | "         | "          | "      |                          |                        |              |
| ".....  | "         | "          | "      |                          |                        |              |
| Little Shuswap.....   | 50 48'6   | 119 41'2   | "      | Sept. 13....             | 4-45p                  | 25 07'5 E    |
| ".....  | "         | "          | "      |                          |                        |              |
| Ashtnolaon station.....   | 49 00'0   | 120 00'0   | 1860   | Aug. 17, 18.....         |                        | 22 44'0 "    |
| On Ashtnolaon river.....  | 49 10'0   | 120 00'0   | "      | July ..                  |                        | 22 10'0 "    |
| 350 yds. south of station 1289<br>traverse.....                           | 50 38'9   | 120 06'9   | 1885   | Sept. 6. . .             | 4-00p                  | 24 59'4 "    |
| ".....  | "         | "          | "      |                          |                        |              |

\* Local disturbance.

SESSIONAL PAPER No. 25a

I X.

RESULTS.

COLUMBIA.

| Month and day.       | Hour and minute. | Dip.    | Month and day.       | Hour and minute. | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------------|------------------|---------|----------------------|------------------|--------------|---------------|-------------|---------------|
| Aug. 2 ...           |                  | 73 42.7 | Aug. 2 ...           |                  |              | 6265          |             | R. W. Haig.   |
| July 15, Aug. 14 ... |                  | 73 30.8 | July 15, Aug. 14 ... |                  |              | 6223          |             | do            |
|                      |                  | 73 37.8 |                      |                  |              |               |             | J. L. Harris. |
|                      |                  | 73 50.4 |                      |                  |              | 6226          |             | do            |
| May 14 ...           | 4 45 to 5 25p    | 75 01.6 | May 14 ...           | 5 30 to 5 55p    |              | 6177          | 47          | O. Klotz.     |
| " 28 ...             | 5 00 to 5 35     | 74 49.5 | " 28 ...             | 5 43 to 6 10p    |              | 6174          | 59          | do            |
|                      | 11 30 to 0 05p   | 74 54.2 |                      | 0 07 to 0 50p    |              | 6168          | 85          | do            |
| June 4 ...           |                  | 74 42.8 | June 4 ...           |                  | 16160        |               |             | C. A. French. |
| July 27-29 ...       |                  | 74 40.1 | July 27-29 ...       |                  | 16142        |               |             | do            |
| " 28 ...             | 4 11 to 4 36p    | 74 50.4 | June 9 ...           | 4 40 to 5 14p    |              | 6171          | 72          | O. Klotz.     |
| June 9 ...           | 9 40 to 10 03a   | 74 52.5 | June 18 ...          |                  |              | 6166          | 59          | do            |
| June 18 ...          |                  | 74 29.9 |                      |                  | 1625         |               |             | C. I.         |
|                      | 3 01 to 3 22p    | 74 41.6 | June 30 ...          | 3 25 to 3 44p    |              | 6167          | 61          | O. Klotz.     |
| June 30 ...          | 4 52 to 5 36p    | 74 26.4 | Aug. 15 ...          | 5 50 to 6 44p    |              | 6144          | 70          | do            |
| Aug. 15 ...          |                  | 74 16.1 | Aug. 15 ...          |                  | 16501        |               |             | C. A. French. |
| Aug. 1, 3, 4 ...     |                  | 74 16.6 | Aug. 1, 3, 4 ...     |                  | 16458        |               |             | do            |
| " 5 ...              |                  | 72 48.8 | Nov. 13 ...          |                  |              | 6149          |             | R. W. Haig.   |
| Nov. 13 ...          |                  | 73 51.8 | Aug. 6, 9 ...        |                  | 16775        |               |             | C. A. French. |
| Aug. 6, 7, 8 ...     | 9 45 to 10 02a   | 74 06.1 | Oct. 21 ...          | 10 08 to 10 27a  |              | 6141          | 44          | W. Ogilvie.   |
| Oct. 21 ...          | 10 51 to 11 10a  | 74 07.8 | " 21 ...             | 10 33 to 10 46a  |              | 6123          | 45          | do            |
| " 21 ...             | 3 08 to 3 27p    | 73 58.9 | " 4 ...              | 3 32 to 3 48p    |              | 6139          | 65          | do            |
| " 4 ...              | 4 18 to 4 40p    | 73 58.2 | " 1 ...              | 3 51 to 4 11p    |              | 6146          | 62          | do            |
| " 4 ...              | 2 55 to 3 20p    | 73 58.0 | Sept. 20 ...         | 3 25 to 3 45p    |              | 6169          | 66          | do            |
| Sept. 20 ...         | 4 20 to 4 45p    | 73 59.0 | " 20 ...             | 3 50 to 4 13p    |              | 6164          | 65          | do            |
| " 20 ...             | 3 25 to 3 41p    | 73 59.0 | " 25 ...             | 3 45 to 4 06p    |              | 6164          | 62          | do            |
| " 25 ...             | 4 33 to 4 59p    | 73 57.1 | " 25 ...             | 4 10 to 4 27p    |              | 6143          | 62          | do            |
| " 25 ...             | 2 48 to 3 11p    | 73 58.8 | " 27 ...             | 3 18 to 3 34p    |              | 6139          | 59          | do            |
| " 27 ...             | 4 10 to 4 30p    | 74 00.4 | " 27 ...             | 3 45 to 4 04p    |              | 6144          | 59          | do            |
| " 27 ...             | 2 30 to 2 50p    | 73 55.2 | " 13 ...             | 2 55 to 3 20p    |              | 6143          | 64          | do            |
| Sept. 13 ...         | 4 05 to 4 25     | 73 48.0 | " 13 ...             | 3 30 to 3 56p    |              | 6170          | 63          | do            |
| " 13 ...             |                  | 72 27.0 | Aug. 17, 18 ...      |                  |              | 6142          |             | R. W. Haig.   |
| Aug. 17, 18 ...      |                  | 72 37.0 | July ...             |                  |              | 6098          |             | do            |
| July ...             | 2 15 to 2 35p    | 73 41.4 | Sept. 6 ...          | 2 40 to 3 03p    |              | 6098          | 84          | W. Ogilvie.   |
| Sept. 6 ...          | 3 30 to 3 32p    | 73 41.0 | " 6 ...              | 3 08 to 3 23p    |              | 6096          | 84          | do            |

TABLE  
MAGNETIC

C. I.—Carnegie Institution.

BRITISH

| Place.                        | Latitude. |      | Longitude. |      | Year. | Month and day.               | Hour and minute. | Declination. |         |
|-------------------------------|-----------|------|------------|------|-------|------------------------------|------------------|--------------|---------|
|                               | °         | '    | °          | '    |       |                              |                  | °            | '       |
| Thompson river.....           | 50        | 41.0 | 129        | 11.0 | 1833  |                              |                  |              |         |
| Kamloops .....                | 50        | 39.9 | 129        | 29.2 | 1885  | Sept. 2                      | 3-50p            | 24           | 20.5 E  |
| " .....                       | "         | "    | "          | "    | "     | " 3                          | 5-30p            | 23           | 35.5 "  |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Nicola.....                   | 50        | 09.0 | 120        | 40.0 | 1908  | Sept. 19-21                  |                  | 25           | 03.0    |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Van Horne .....               | 50        | 44.4 | 120        | 50.3 | 1885  |                              |                  |              |         |
| St. Cloud.....                | 50        | 45.9 | 121        | 07.8 | "     | Aug. 16                      | 4-55p            | 23           | 51.5 E  |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Ashcroft (C. I. S.).....      | 50        | 44.6 | 121        | 17.0 | 1908  | Sept. 14, 15                 |                  | 27           | 46.9 E  |
| " .....                       | "         | "    | "          | "    | 1907  | 7                            |                  | 27           | 36.1 E  |
| Near Black canyon.....        | 50        | 39.6 | 121        | 17.9 | 1885  | Aug. 9                       | 4-55p            | 27           | 22.5 "  |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Spence's bridge.....          | 50        | 24.3 | 121        | 20.7 | "     | " 2                          | Noon             | 23           | 43.8 E  |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| " .....                       | 50        | 25.0 | 121        | 21.0 | 1908  | Sept. 17, 18                 |                  | 26           | 39.4    |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Chilukweyuk .....             | 49        | 02.0 | 121        | 23.0 | 1859  |                              |                  |              |         |
| Chilukweyuk camp.....         | 49        | 06.0 | 121        | 23.0 | "     |                              |                  |              |         |
| Bridge creek (100-mile).....  | 51        | 39.0 | 121        | 27.0 | 1908  | Sept. 8, 9                   |                  | 26           | 47.4    |
| North Bend .....              | 49        | 52.0 | 121        | 27.0 | "     | " 23-26                      |                  | 25           | 48.0    |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Barkerville.....              | 53        | 04.0 | 121        | 30.0 | 1908  | Aug. 22-24                   |                  | 28           | 07.3 E. |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Salmon river .....            | 49        | 58.3 | 121        | 30.6 | 1885  | July 12                      | 5-00p            | 24           | 59.0 "  |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Cisco station.....            | 50        | 07.4 | 121        | 34.4 | "     |                              |                  |              |         |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Clinton .....                 | 51        | 06.0 | 121        | 35.0 | 1908  | Aug. 13-16                   |                  | 26           | 26.4    |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Agassiz.....                  | 49        | 15.0 | 121        | 45.0 | "     | Oct. 1, 2                    |                  | 25           | 23.6    |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Williams lake (150 mile)..... | 52        | 06.0 | 121        | 56.0 | "     | Sept. 3-5                    |                  | 28           | 52.8 E. |
| " .....                       | "         | "    | "          | "    | "     |                              |                  |              |         |
| Harrison river .....          | 49        | 13.4 | 121        | 56.0 | 1885  | June 14                      | 6-20p            | 22           | 21.3 "  |
| " .....                       | "         | "    | "          | "    | "     | " 14                         | 6-25p            | 22           | 25.4 "  |
| Schweltza lake station.....   | 49        | 02.0 | 122        | 00.0 | 1859  | July 4, 5                    |                  | 21           | 37.0 "  |
| Sumas prairie .....           | 49        | 01.0 | 122        | 12.0 | 1858  | { Oct. 4, 5 }<br>{ Nov. 10 } |                  | 21           | 30.0 "  |

SESSIONAL PAPER No. 25a

IX—*Con.*

RESULTS—*Con.*

COLUMBIA—*Con.*

| Month and day. | Hour and minute.   | Dip.    | Month and day. | Hour and minute.   | Hor. intens. | Total intens. | Temperature | Observer.     |
|----------------|--------------------|---------|----------------|--------------------|--------------|---------------|-------------|---------------|
| April          |                    | 73 43 0 |                |                    |              | 5939          | °           | D. Douglas.   |
| Sept. 2        | 2-00<br>to 2-23p   | 73 35.8 | Sept. 2        | 2-27<br>to 2-42p   |              | 6071          | 75          | Wm. Ogilvie   |
| " 2            | 3-25<br>to 3-48p   | 73 34.2 | " 2            | 2-53<br>to 3-18p   |              | 6065          | 75          | do            |
| " 3            | 3-48<br>to 4-10p   | 73 37.5 | " 3            | 4-15<br>to 4-30p   |              | 6054          | 79          | do            |
| " 3            | 5-00<br>to 5-20p   | 73 39.0 | " 3            | 4-35<br>to 4-54p   |              | 6085          | 79          | do            |
| Sept. 19, 20.  |                    | 72 54.0 | Sept. 19, 20.  |                    | 1755         |               |             | C. A. French. |
| " 21           |                    | 72 53.4 | " 21           |                    | 1753         |               |             | do            |
| Aug. 23        | 2-50<br>to 3-15p   | 73 28.0 | Aug. 23        | 3-20<br>to 3-43p   |              | 6037          | 71          | Wm. Ogilvie.  |
| Aug. 16        | 2-45<br>to 3-10p   | 74 00.8 | Aug. 16        | 3-18<br>to 3-40p   |              | 6166          | 94          | do            |
| " 16           | 4-22<br>to 4-47p   | 74 02.6 | " 16           | 3-50<br>to 4-10p   |              | 6157          | 96          | do            |
| Sept. 11, 12,  |                    |         |                |                    |              |               |             |               |
| " 14           |                    | 73 26.1 | Sept. 14, 15.  |                    | 1722         |               |             | C. A. French. |
| " 12           |                    | 73 26.8 | " 12           |                    | 1721         |               |             | do            |
|                |                    | 73 22.2 |                |                    | 1725         |               |             | C. I.         |
| Aug. 9         | 2-48<br>to 3-06p   | 73 37.5 | Aug. 9         | 3-10<br>to 3-32p   |              | 6123          | 88          | Wm. Ogilvie.  |
| " 9            | 4-08<br>to 4-38    | 73 40.3 | " 9            | 3-42<br>to 4-02p   |              | 6111          | 88          | do            |
| " 2            | 9-45<br>to 10-20a  | 73 26.8 | " 2            | 10-25<br>to 10 53a |              | 6048          | 85          | do            |
| " 2            | 11-47<br>to 12-17a | 73 27.2 | " 2            | 11-05<br>to 11-35a |              | 6072          | 85          | do            |
| Sept. 17       |                    | 72 58.9 | Sept. 16, 17.  |                    | 1737         |               |             | C. A. French. |
| " 18           |                    | 72 57.6 | " 18           |                    | 1741         |               |             | do            |
| " 7            |                    | 72 31.0 | Sept. 7        |                    |              | 6077          |             | R. W. Haig.   |
|                |                    | 72 22.2 |                |                    |              | 6125          |             | J. S. Harris. |
| Sept. 8, 9.    |                    | 73 35.1 | Sept. 8, 9.    |                    | 1717         |               |             | C. A. French. |
| " 23-25.       |                    | 72 32.1 | Sept. 24-25.   |                    | 1737         |               |             | do            |
| " 26           |                    | 72 31.2 |                |                    | 1795         |               |             | do            |
| Aug. 22, 23.   |                    | 74 58.0 | Aug. 22, 23.   |                    | 1571         |               |             | do            |
| " 21           |                    | 74 57.6 | " 21           |                    | 1569         |               |             | do            |
| July 12        | 3-20<br>to 3-48p   | 72 39.4 | July 12        | 3-50<br>to 4-15p   |              | 6063          | 85          | W. Ogilvie.   |
| " 12           | 5-18<br>to 5-38p   | 72 40.7 | " 12           | 4-22<br>to 4-41p   |              | 6052          | 82          | do            |
| " 19           | 1-50<br>to 2-16p   | 72 44.7 | " 19           | 2-20<br>to 2-44p   |              | 6066          | 84          | do            |
| " 19           | 3-16<br>to 3-49p   | 72 41.1 | " 19           | 2-50<br>to 3-10p   |              | 6067          | 80          | do            |
| Aug. 14, 15.   |                    | 73 27.6 | Aug. 14, 15.   |                    | 1704         |               |             | C. A. French. |
| " 13           |                    | 73 25.1 | " 13           |                    | 1722         |               |             | do            |
| { Sept. 28 }   |                    | 71 34.9 | Oct. 1, 2      |                    | 1892         |               |             | do            |
| { Oct. 1, 2 }  |                    | 71 36.1 | Sept. 28       |                    | 1890         |               |             | do            |
| Sept. 28       |                    | 74 12.3 | " 3, 5         |                    | 1652         |               |             | do            |
| Sept. 3, 5     |                    | 74 12.4 | " 5            |                    | 1651         |               |             | do            |
| " 5            |                    |         |                |                    |              |               |             | do            |
| June 14        | 4-00<br>to 4-30p   | 72 28.3 | June 14        | 4-35<br>to 5-00p   |              | 5994          | 75          | W. Ogilvie.   |
| " 14           | 5-33<br>to 5-54p   | 72 28.0 | " 14           | 5-05<br>to 5-25p   |              | 6011          | 73          | do            |
| July 4, 5.     |                    | 72 04.0 | July 4, 5      |                    |              | 6125          |             | R. W. Haig.   |
| { Oct. 4, 5 }  |                    | 72 22.0 | { Oct. 4, 5 }  |                    |              | 6163          |             | do            |
| { Nov. 10 }    |                    |         | { Nov. 10 }    |                    |              |               |             | do            |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC

BRITISH

C. I.—Carnegie Institution.  
C. S.—Coast Survey.

| Place.                         | Latitude. | Longitude. | Year.  | Month and day.       | Hour and minute. | Declination. |
|--------------------------------|-----------|------------|--------|----------------------|------------------|--------------|
| Alexandria                     | 52 35 0   | 122 28 0   | 1908   | Aug. 30<br>(Sept. 1) |                  | 28 16.2      |
| " <sup>41M</sup>               |           |            |        |                      |                  |              |
| Fort Alexandria                | 52 33 0   | 122 29 0   | 1833   |                      |                  |              |
| Quesnel                        | 52 50 0   | 122 32 0   | 1908   | Aug. 26-28           |                  | 24 19.0      |
| "                              | "         | "          |        |                      |                  |              |
| Port Hammond                   | 49 12 1   | 122 38.9   | 1885   | May 26               | 6-38p            | 22 46.2 E.   |
| "                              |           |            |        |                      |                  |              |
| Camp Semiamu                   | 49 01.0   | 122 46 0   | 1857   |                      |                  |              |
| Station Semiamu                | 49 00.7   | 122 46 2   | 1857   |                      |                  |              |
| "                              |           |            |        |                      |                  |              |
| Port Moody                     | 49 17 0   | 122 52.6   | 1885   | June 3.              | 4-45p            | 22 45.8 E.   |
| "                              |           |            |        | " 3.                 | 4-55p            | 22 46.3 "    |
| New Westminster                | 49 13 0   | 122 53 0   | 1862   |                      |                  |              |
| Vancouver                      | 49 18.0   | 123 07 0   | 1898 4 |                      |                  | 24 30.0 E.   |
| Vancouver (Brockton Pt.)       | 49 18 0   | 123 07 0   | 1908   | Oct. 5-8             |                  | 25 23.3      |
| "                              |           |            |        |                      |                  |              |
| Burrard inlet                  | 49 16.0   | 123 10 0   | 1859   |                      |                  |              |
| Victoria (C. I. station)       | 48 25.0   | 123 21 0   | 1908   | Oct. 13, 14          |                  | 24 34.0      |
| "                              |           |            |        |                      |                  |              |
| "                              | 48 25.0   | 123 21 0   | 1907 7 |                      |                  | 24 15.2 E.   |
| "                              | 48 26.0   | 123 25 0   | 1858   |                      |                  |              |
| "                              | 48 25.8   | 123 22 2   | 1880   |                      |                  |              |
| Victoria, Laurel point         | 48 25.4   | 123 22.5   | 1862   |                      |                  |              |
| Esquimalt                      | 48 25.0   | 123 26.0   | 1881 8 |                      |                  | 22 55.6 "    |
| "                              | 48 26 0   | 123 27.0   | 1859   |                      |                  |              |
| "                              |           |            |        |                      |                  |              |
| "                              |           |            |        |                      |                  |              |
| "                              |           | 123 28.0   | 1862   |                      |                  |              |
| "                              |           |            | 1892 7 |                      |                  |              |
| "                              |           |            | 1898 3 |                      |                  | 23 42.9 E.   |
| Nanaimo (Jesse island)         | 49 13 0   | 123 52.0   | 1908   | Oct. 17, 18          |                  | 25 15.3      |
| "                              |           |            |        |                      |                  |              |
| Departure bay, Vancouver I.    | 49 12.6   | 123 57.0   | 1881   | Oct. 7               |                  | 23 55.6 E.   |
| "                              | 49 12.6   | 123 58.5   | 1860   |                      |                  |              |
| Nanaimo                        | 49 10 0   | 124 00.0   | 1862   |                      |                  |              |
| Stuart lake                    | 54 27 0   | 124 20 0   | 1833   |                      |                  |              |
| Fraser lake                    | 54 03 0   | 124 40 0   | 1833   |                      |                  |              |
| Bayne sound (Maple spit)       | 49 28.0   | 124 45.0   | 1898 4 |                      |                  | 24 25.7 E.   |
| " (Beak point)                 | 49 36.0   | 124 51.0   | 1898 6 |                      |                  | 24 14.1 "    |
| Union                          | 49 36.0   | 124 54.0   | 1900 8 |                      |                  | 25 55.6 "    |
| "                              |           |            | 1904 3 |                      |                  | 26 05.6 "    |
| Union (1)                      | 49 36.0   | 124 54 0   | 1906 5 |                      |                  | 26 00.9 E.   |
| Union (2)                      |           |            |        |                      |                  | 26 17.4 "    |
| Waddington harbour             | 50 54 0   | 124 49.5   | 1881   | July 30              |                  | 25 22.0 "    |
| Henry bay, Vancouver island    | 49 36.0   | 124 51 0   | 1860   |                      |                  |              |
| Hecate bay                     | 49 15.0   | 125 56.0   | 1861   |                      |                  |              |
| Port Neville                   | 50 31 0   | 126 04 0   | 1860   |                      |                  |              |
| Anchorage cove, Kingcome inlet | 50 52.8   | 126 11.7   | 1881   | Aug. 3               |                  | 25 42.7 "    |
| Nootka sound, Vancouver island | 49 36.0   | 126 37 0   | 1778   |                      |                  |              |
| "                              |           |            | 1791   |                      |                  |              |
| "                              |           |            | 1792   |                      |                  |              |
| Friendly cove                  | 49 35.5   | 126 37.5   | 1881   | Sept. 27             |                  | 23 36.2 "    |
| Beaver harbour                 | 50 43 0   | 127 25.0   | 1860   |                      |                  |              |
| North harbour, Quatsino sound  | 50 29.4   | 128 03.6   | 1881   | Sept. 24, 25         |                  | 24 53.7 "    |
| Port McLoughlin                | 52 08 4   | 128 10.3   | "      | Aug. 7               |                  | 26 42.9 "    |

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IX—Con.

RESULTS—Con.

COLUMBIA—Con.

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.          |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|--------------------|
| Aug. 30, 31    |                  | 74 20.9 | Aug. 30, 31    |                  | 1639         |               |              | C. A. French.      |
| Sept. 1        |                  | 74 18.4 | Sept. 1        |                  | 1647         |               |              | " "                |
| May            |                  | 74 50.0 |                |                  |              | 5985          |              | D. Douglas.        |
| Aug. 26, 27    |                  | 74 51.1 | Aug. 26, 27    |                  | 1586         |               |              | C. A. French.      |
|                |                  | 74 49.0 | " 28           |                  | 1591         |               |              | "                  |
| May 26         | 3-10 to 3-43p    | 71 58.6 | May 26         | 3-48 to 4-15p    |              | 6030          | 68           | W. Ogilvie.        |
| " 26           | 5-00 to 5-35p    | 71 59.0 | " 26           | 4-20 to 4-48p    |              | 6064          | 66           | "                  |
| Sept.          |                  | 72 02.0 | Sept.          |                  |              | 6114          |              | J. S. Harris.      |
| (Sept. 8, 9)   |                  | 71 57.0 | (Sept. 8, 9)   |                  |              | 6106          |              | J. S. Harris.      |
| (Oct. 18)      |                  |         | (Oct. 18)      |                  |              |               |              |                    |
| June 3         | 2-15 to 2-52p    | 72 13.0 | June 3         | 2-55 to 3-30p    |              | 6118          | 70           | W. Ogilvie.        |
| " 3            | 4-12 to 4-35p    | 72 10.5 | " 3            | 3-36 to 3-50p    |              | 6102          | 70           | "                  |
|                |                  | 72 15.0 |                |                  |              |               |              | Richards.          |
|                |                  | 71 51.5 |                |                  | 1870         |               |              | British Navy.      |
| Oct. 6-8       |                  | 71 42.4 | Oct. 7, 8      |                  | 1878         |               |              | C. A. French.      |
| " 3            |                  | 71 43.7 | " 3            |                  | 1867         |               |              | "                  |
|                |                  | 72 14.0 |                |                  |              |               |              | Richards.          |
| Oct. 12-14     |                  | 71 19.3 | Oct. 13, 14    |                  | 1876         |               |              | C. A. French.      |
| " 10           |                  | 71 17.0 | " 10           |                  | 1878         |               |              | "                  |
|                |                  | 71 18.1 |                |                  | 1881         |               |              | C. I.              |
|                |                  | 71 39.0 |                |                  |              |               |              | K. Friesach.       |
| May 4          |                  | 71 22.1 | May 4          |                  |              | 5925          |              | W. H. Dall & Baker |
|                |                  | 71 39.0 |                |                  |              |               |              | Richards.          |
|                |                  | 71 39.3 |                |                  | 1881         |               |              | C. S.              |
|                |                  | 71 34.1 | (Jan. 24)      |                  |              | 6042          |              | R. W. Haig.        |
|                |                  | 71 52.0 | (Mar. 22)      |                  |              |               |              | Richards.          |
|                |                  | 71 27.4 |                |                  | 1905         |               |              | French Navy.       |
|                |                  | 71 32.4 |                |                  | 1868         |               |              | British Navy.      |
| Oct. 17, 18    |                  | 71 20.2 | Oct. 17        |                  | 1883         |               |              | C. A. French.      |
| " 18           |                  | 71 21.5 | " 18           |                  | 1879         |               |              | "                  |
| " 6            |                  | 71 42.2 | Oct. 7         |                  |              | 5973          |              | H. E. Nichols.     |
| May 6          |                  | 71 29.2 |                |                  |              |               |              | W. H. Dall & Baker |
|                |                  | 71 54.0 |                |                  |              |               |              | Richards.          |
| June           |                  | 76 09.0 | June           |                  |              | 6090          |              | D. Douglas.        |
| "              |                  | 75 48.0 | June           |                  |              | 6059          |              | "                  |
|                |                  | 71 53.6 |                |                  | 1844         |               |              | British Navy.      |
|                |                  | 71 56.5 |                |                  | 1854         |               |              | "                  |
|                |                  | 71 30.2 |                |                  |              |               |              | C. S.              |
|                |                  | 71 26.4 |                |                  | 1898         |               |              | C. S.              |
|                |                  | 71 24.2 |                |                  | 1901         |               |              | C. S.              |
|                |                  | 71 25.3 |                |                  | 1910         |               |              | "                  |
| July 30        |                  | 71 58.6 | July 30        |                  |              | 5960          |              | H. E. Nichols.     |
|                |                  | 72 25.0 |                |                  |              |               |              | Richards.          |
|                |                  | 72 37.0 |                |                  |              |               |              | "                  |
|                |                  | 72 19.0 |                |                  |              |               |              | "                  |
| Aug. 3         |                  | 72 46.1 | Aug. 3         |                  |              | 5928          |              | H. E. Nichols.     |
| April          |                  | 72 29.0 |                |                  |              |               |              | J. Cook.           |
| Aug. 16, 17    |                  | 70 29.7 |                |                  |              |               |              | Don. A. Malespina. |
| Oct.           |                  | 73 56.0 |                |                  |              |               |              | G. Vancouver.      |
| Sept. 26       |                  | 71 33.0 | Sept. 27       |                  |              | 5950          |              | H. E. Nichols.     |
|                |                  | 72 37.0 |                |                  |              |               |              | Richards.          |
| Sept. 22       |                  | 71 41.3 | Sept. 24, 25   |                  |              | 5942          |              | H. E. Nichols.     |
| Aug. 5, 6      |                  | 73 12.1 | Aug. 7         |                  |              | 6038          |              | "                  |

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TABLE

MAGNETIC

BRITISH

| Place.                                     | Latitude. | Longitude. | Year. | Month and day.                | Hour and minute. | Declination. |
|--|-----------|------------|-------|-------------------------------|------------------|--------------|
| Salmon cove, Observatory inlet             | 55 15 6   | 129 52 0   | 1793  | Between July 27 and August 12 |                  | 25 18 0 "    |
| Port Simpson.....                          | 54 33 6   | 130 22 8   | 1881  | Aug. 10, 12.                  |                  | 27 54 1 "    |
| " .....                                    | 54 33 5   | 130 23 8   | 1862  | .....                         |                  | .....        |
| Rose harbour, Queen Charlotte island. .... | 52 09 1   | 131 15 0   | 1881  | Sept. 20....                  |                  | 26 60 6 "    |
| Lake Lindeman.....                         | 59 47 2   | 135 04 8   | 1887  | June 25....                   | 1-00p            | 32 16 8 "    |
| " .....                                    | "         | "          | "     |                               |                  | .....        |



SESSIONAL PAPER No. 25a

IX.—*Con.*

RESULTS.—*Con.*

COLUMBIA—*Con.*

| Month and day.                 | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.      |
|--------------------------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|----------------|
| Between July 27 and August 12. |                  | 75 54.5 |                |                  |              |               |              | Vancouver.     |
| Aug. 9.                        |                  | 74 21.0 | Aug. 10, 12.   |                  |              | 5987          |              | H. E. Nichols. |
|                                |                  | 74 53.0 |                |                  |              |               |              | Richards.      |
| Sept. 19.                      |                  | 72 30.2 | Sept. 20.      |                  |              | 5957          |              | H. E. Nichols. |
| June 25.                       | 10 55 to 11-19a  | 77 03.9 | June 25        | 11-23 to 11-50a  |              | 5987          | 56           | Wm. Ogilvie.   |
| " 25.                          | 0-19 to 0-47p    | 77 06.5 | " 25.          | 11-52a to 0-13p  |              | 5973          | 56           | "              |

TABLE  
MAGNETIC  
YUKON AND  
(North of

| Place.                           | Latitude. |      | Longitude. |      | Year. | Month and day. | Hour and minute. | Declination. |         |
|----------------------------------|-----------|------|------------|------|-------|----------------|------------------|--------------|---------|
|                                  | °         | '    | °          | '    |       |                |                  | °            | '       |
| Portage du Grand D-tour....      | 60        | 22 0 | 113        | 00 9 | 1844  | June 25....    | 5-58p            | 35           | 15 0 E. |
| Fort Resolution .....            | 60        | 10 7 | 113        | 46 0 | 1825  | .....          | .....            | 29           | 15 6 "  |
| " .....                          | "         | "    | "          | "    | 1844  | June 22....    | 10-20a           | 37           | 12 5 "  |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | 1888  | Sept. 20....   | 4-45p            | 38           | 20 2 E. |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Fishing station, Little lake ... | 61        | 11 7 | 116        | 38 0 | 1844  | June 20....    | 6-02a            | 35           | 28 0 E. |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Fort Confidence.....             | 66        | 54 0 | 118        | 49 0 | 1839  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | 1849  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | 1850  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Fort Simpson .....               | 61        | 51 7 | 121        | 25 3 | 1825  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | 1844  | Mar. 30 ...    | 7-58a            | 37           | 52 0 E. |
| " .....                          | "         | "    | "          | "    | "     | " 30....       | 9-13a            | 38           | 43 0 "  |
| " .....                          | "         | "    | "          | "    | "     | " 30....       | 3-46p            | 37           | 28 0 "  |
| " .....                          | "         | "    | "          | "    | "     | " 30....       | 4-56p            | 38           | 02 0 "  |
| " .....                          | "         | "    | "          | "    | "     | May 8....      | 9-00a            | 37           | 57 0 "  |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | 1888  | Aug. 27....    | 8-20a            | 37           | 42 4 E. |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Fort Norman.....                 | 64        | 40 6 | 124        | 44 8 | 1844  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | 64        | 54 3 | 125        | 43 1 | 1888  | July 29....    | 8-15p            | 33           | 39 0 E. |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Mackenzie river.....             | 64        | 26 7 | 125        | 03 8 | "     | Aug. 5....     | 7 17p            | 41           | 34 6 "  |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| Fort Good Hope.....              | 66        | 16 0 | 128        | 31 0 | 1844  | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |
| " .....                          | "         | "    | "          | "    | "     | .....          | .....            | .....        | .....   |

SESSIONAL PAPER No. 25a

X.

RESULTS.

NORTHWEST TERRITORIES.

Latitude 60°).

| Month and day. | Hour and minute. | Dip.    | Month and day. | Hour and minute. | Hor. intens. | Total intens. | Temperature. | Observer.               |
|----------------|------------------|---------|----------------|------------------|--------------|---------------|--------------|-------------------------|
| June 25.       |                  | 82 33.6 |                |                  |              |               |              | J. H. Lefroy.           |
| June 22.       | a.m.             | 82 43.5 | June 22.       |                  |              | 6428          |              | J. Franklin.            |
| " 22.          | a.m.             | 82 45.4 | " 22.          |                  |              | 6439          |              | J. H. Lefroy.           |
|                |                  |         | " 22.          |                  |              | 6437          |              | "                       |
| Sept. 19.      | 4 00 to 4-23p    | 82 10.1 | Sept. 19.      | 4 34 to 4-49p    |              | 6308          | 60           | Wm. Ogilvie.            |
| " 19.          | 5-15 to 5-32p    | 82 08.0 | " 19.          | 4 51 to 5-08p    |              | 6307          | 60           | "                       |
| Mar. 18.       |                  | 82 08.7 | June 20.       |                  |              | 6390          |              | J. H. Lefroy.           |
| June           |                  | 84 48.0 | " 20.          |                  |              | 6369          |              | "                       |
| October        |                  | 84 49.4 | October        |                  |              | 6289          |              | T. Simpson.             |
| November.      |                  | 84 51.1 | "              |                  |              | 6179          |              | J. Ra. & J. Richardson. |
| December       |                  | 84 50.0 | November.      |                  |              | 6101          |              | "                       |
|                |                  |         |                |                  |              | 6454          |              | "                       |
|                |                  |         | December       |                  |              | 5994          |              | "                       |
|                |                  |         |                |                  |              | 6567          |              | "                       |
| January.       |                  | 84 48.8 | January        |                  |              | 6467          |              | "                       |
| February.      |                  | 84 53.9 | February.      |                  |              | 6162          |              | "                       |
| March.         |                  | 84 50.4 | "              |                  |              | 6406          |              | "                       |
|                |                  |         | March          |                  |              | 6101          |              | "                       |
|                |                  |         | "              |                  |              | 6363          |              | "                       |
| Aug. 5.        |                  | 81 53.1 |                |                  |              |               |              | J. Franklin.            |
| Mar. 28.       | 4-05p            | 81 53.8 | May 2.         |                  |              | 6314          |              | J. H. Lefroy.           |
| May 12.        | 12-00a           | 81 50.7 | " 2.           |                  |              | 6394          |              | "                       |
|                |                  |         | " 2.           |                  |              | 6344          |              | "                       |
|                |                  |         | " 2.           |                  |              | 6411          |              | "                       |
|                |                  |         | " 2.           |                  |              | 6388          |              | "                       |
|                |                  |         | June 12.       |                  |              | 6373          |              | "                       |
|                |                  |         | " 12.          |                  |              | 6334          |              | "                       |
|                |                  |         | " 12.          |                  |              | 6373          |              | "                       |
|                |                  |         | " 12.          |                  |              | 6427          |              | "                       |
|                |                  |         | " 12.          |                  |              | 6350          |              | "                       |
| Aug. 25.       | 6-00 to 6-20p    | 81 17.2 | Aug. 25.       | 6 23 to 6 44p    |              | 6249          | 66           | Wm. Ogilvie.            |
| " 27.          | 5-41 to 6-03a    | 81 20.9 | " 27.          | 6-06 to 6-26a    |              | 6230          | 46           | "                       |
| " 27.          | 6-56 to 7-16a    | 81 17.4 | " 27.          | 6-30 to 6-47a    |              | 6225          | 46           | "                       |
| May 28.        |                  | 82 34.3 | May 28.        |                  |              | 6250          |              | J. H. Lefroy            |
|                |                  |         | June 2.        |                  |              | 6235          |              | "                       |
|                |                  |         | " 2.           |                  |              | 6304          |              | "                       |
|                |                  |         | " 2.           |                  |              | 6385          |              | "                       |
| July 29.       | 5-15 to 5-35p    | 81 59.1 | July 29.       | 5-40 to 6-00p    |              | 6154          | 76           | Wm. Ogilvie.            |
| " 29.          | 7-38 to 8-00p    | 82 01.9 | " 29.          | 6-03 to 6-40p    |              | 6156          | 74           | "                       |
| Aug. 5.        | 4-48 to 5-06p    | 81 58.2 | Aug. 5.        | 5-12 to 5-30p    |              | 6142          | 68           | "                       |
| " 5.           | 6-35 to 6-55p    | 81 54.0 | " 5.           | 5-35 to 6-00p    |              | 6176          | 66           | "                       |
| May 29.        | 10-40p           | 82 55.8 | May 29.        |                  |              | 6268          |              | J. H. Lefroy.           |
| " 29.          | 10-40p           | 82 56.1 | " 29.          |                  |              | 6277          |              | "                       |
|                |                  |         | " 29.          |                  |              | 6297          |              | "                       |
|                |                  |         | " 29.          |                  |              | 6297          |              | "                       |
|                |                  |         | " 29.          |                  |              | 6409          |              | "                       |

9-10 EDWARD VII., A. 1910

TABLE  
MAGNETIC  
YUKON AND  
(North of

| Place.                          | Latitude. | Longitude. | Year. | Month and day. | Hour and minute. | Declination. |
|---------------------------------|-----------|------------|-------|----------------|------------------|--------------|
| Fort Good Hope.....             | 66 16'0   | 128 50 0   | 1888  | July 13....    | 6-10p            | 41 30'9 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Marsh lake, Yukon river.....    | 60 21 1   | 134 17'2   | 1887  | July 17....    | 6-15p            | 32 46'1 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Fort McPherson.....             | 67 26'0   | 134 57'0   | 1888  | June 22....    | 4-25p            | 46 00'8 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Lewes river .....               | 60 42'3   | 135 04 1   | 1887  | June 24....    | 6-40p            | 30 55'7 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| " .....                         | 62 04'4   | 136 04 0   | "     | Aug. 7....     | 7-20p            | 33 54'8 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Fort Selkirk .....              | 62 47'6   | 137 24'9   | "     | Aug. 18....    | 6-00p            | 34 18'0 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Richardsons Chain.....          | 69 01 0   | 137 25'0   | 1826  | "              | "                | "            |
| La Pierre's House.....          | 67 23'0   | 136 54.0   | 1888  | "              | "                | "            |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Yukon river .....               | 63 20'3   | 139 28 5   | 1887  | Aug. 27....    | 5-40p            | 33 52'8 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Mouth of White river.....       | 63 11'9   | 139 37 8   | "     | Aug. 26....    | 9-45a            | 34 27 0 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Porcupine river .....           | 65 43'0   | 139 40'0   | 1888  | May 16....     | 11-45a           | 37 44 3 E.   |
| " .....                         | "         | "          | "     | " 20....       | 7-02p            | 37 24'2 "    |
| " .....                         | "         | "          | "     | "              | "                | "            |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Yukon river .....               | 64 25'5   | 140 31 7   | 1887  | Sept. 12....   | 10-15a           | 35 01'1 E.   |
| " .....                         | "         | "          | "     | "              | "                | "            |
| Clarence bay, Arctic ocean..... | 69 38'0   | 140 51 0   | 1826  | "              | "                | "            |
| Boundary, Observatory.....      | 64 41'0   | 140 54 0   | 1888  | Feb. 27....    | 4-15p            | 35 45'3 E.   |
| " .....                         | "         | "          | "     | " 28....       | 11-45a           | 35 47'5 "    |
| " .....                         | "         | "          | "     | "              | "                | "            |
| " .....                         | "         | "          | "     | "              | "                | "            |
| " .....                         | "         | "          | "     | "              | "                | "            |
| " .....                         | "         | "          | "     | "              | "                | "            |

SESSIONAL PAPER No. 25a

X—*Con.*

RESULTS—*Con.*

NORTHWEST TERRITORIES—*Con.*

Latitude 60°).

| Month and day.    | Hour and minute.   | Dip.    | Month and day.    | Hour and minute.   | Hor. intens. | Total intens. | Temperature | Observer.    |
|-------------------|--------------------|---------|-------------------|--------------------|--------------|---------------|-------------|--------------|
| July 13. . . . .  | 4-05<br>to 4-26p   | 82 17 9 | July 13. . . . .  | 4 33<br>to 4-54p   |              | 6123          | 72          | Wm. Ogilvie. |
| " 13. . . . .     | 5-20<br>to 5-44p   | 82 18 9 | " 13. . . . .     | 4-58<br>to 5-17p   |              | 6117          | 72          | "            |
| July 17. . . . .  | 4-39<br>to 5-05p   | 77 31 1 | " 17. . . . .     | 5-41<br>to 6-01p   |              | 6035          |             | "            |
| " 17. . . . .     | 6-08<br>to 6-31p   | 77 33 7 | " 17. . . . .     | 5-08<br>to 5-35p   |              | 6009          |             | "            |
| June 22. . . . .  | 2-15<br>to 2-35p   | 81 51 8 | June 22. . . . .  | 2-38<br>to 2-55p   |              | 6089          | 72          | "            |
| " 22. . . . .     | 3-44<br>to 4-06p   | 81 45 9 | " 22. . . . .     | 2-58<br>to 3-18p   |              | 6085          | 73          | "            |
| July 24. . . . .  | 4-22<br>to 4-50p   | 77 42 8 | July 24. . . . .  | 4-55<br>to 5-14p   |              | 5948          | 76          | Wm. Ogilvie. |
| " 24. . . . .     | 6-05<br>to 6-35p   | 77 45 2 | " 24. . . . .     | 5-18<br>to 5-36p   |              | 5935          | 76          | "            |
| Aug. 7. . . . .   | 5-02<br>to 5-24p   | 78 16 4 | Aug. 7. . . . .   | 5-30<br>to 5-52p   |              | 6026          | 72          | "            |
| " 7. . . . .      | 6-40<br>to 7-00p   | 78 16 4 | " 7. . . . .      | 5-55<br>to 6-13p   |              | 6023          | 70          | "            |
| " 18. . . . .     | 4-00<br>to 4-22p   | 79 08 2 | " 18. . . . .     | 4-28<br>to 4-50p   |              | 6019          | 81          | "            |
| " 18. . . . .     | 5-14<br>to 5-40p   | 79 08 4 | " 18. . . . .     | 4-53<br>to 5-09p   |              | 6012          | 78          | "            |
|                   |                    | 82 22 0 |                   |                    |              |               |             | J. Franklin. |
| June 7. . . . .   | 8-12<br>to 8-32p   | 81 23 7 | June 7. . . . .   | 8-36<br>to 8-55p   |              | 5989          | 48          | Wm. Ogilvie. |
| " 7. . . . .      | 9-22<br>to 9-40p   | 81 25 7 | " 7. . . . .      | 9-00<br>to 9-18p   |              | 5995          | 48          | "            |
| Aug. 27. . . . .  | 3-25<br>to 3-45p   | 78 35 2 | Aug. 27. . . . .  | 3-50<br>to 4-10p   |              | 5960          | 67          | "            |
| " 27. . . . .     | 4-48<br>to 5-12p   | 78 38 3 | " 27. . . . .     | 4-22<br>to 4-44p   |              | 5965          | 64          | "            |
| " 26. . . . .     | 8-00<br>to 8-25a   | 78 20 3 | " 26. . . . .     | 8-28<br>to 8-50a   |              | 5966          | 54          | "            |
| " 26. . . . .     | 9-15<br>to 9-40a   | 78 18 6 | " 26. . . . .     | 8-55<br>to 9-12a   |              | 5971          | 55          | "            |
| May 16. . . . .   | 9-45<br>to 10-07a  | 79 57 6 | May 16. . . . .   | 10-15<br>to 10-33a |              | 6023          | 44          | "            |
| " 16. . . . .     | 11-00<br>to 11-18a | 79 57 1 | " 16. . . . .     | 10-39<br>to 10-45a |              | 6012          | 44          | "            |
| " 20. . . . .     | 4 24<br>to 4-45p   | 79 51 5 | " 20. . . . .     | 4-50<br>to 5-06p   |              | 5949          | 41          | "            |
| " 20. . . . .     | 5-30<br>to 5-55p   | 79 53 2 | " 20. . . . .     | 5-08<br>to 5-26p   |              | 6004          | 41          | "            |
| Sept. 12. . . . . | 7-12<br>to 8-20a   | 78 45 5 | Sept. 12. . . . . | 8-25<br>to 8-40a   |              | 5942          | 46          | "            |
| " 12. . . . .     | 9-15<br>to 9-35a   | 78 46 9 | " 12. . . . .     | 8-47<br>to 9-10a   |              | 5930          | 48          | "            |
|                   |                    | 83 27 0 |                   |                    |              |               |             | J. Franklin. |
| Jan. 3. . . . .   | 0-40<br>to 1-22p   | 78 49 7 | Jan. 3. . . . .   | 1-40<br>to 1-50p   |              | 5994          | 10          | Wm. Ogilvie. |
| " 3. . . . .      | 2-25<br>to 2-50p   | 78 50 1 | " 3. . . . .      | 1-55<br>to 2-20p   |              | 5995          | 9 5         | "            |
| Feb. 27. . . . .  | 1-40<br>to 2-01p   | 78 50 0 | Feb. 27. . . . .  | 2-12<br>to 2-30p   |              | 6004          | 12          | "            |
| " 27. . . . .     | 3 10<br>to 3-29p   | 78 48 9 | " 27. . . . .     | 2-45<br>to 3-00p   |              | 5993          | 12          | "            |
| " 28. . . . .     | 9-25<br>to 9-43p   | 78 48 6 | " 28. . . . .     | 9-55<br>to 10-09a  |              | 6005          | 7           | "            |
| " 28. . . . .     | 10-53<br>to 11-10a | 78 50 1 | " 28. . . . .     | 10 20<br>to 10-34a |              | 6004          | 9           | "            |

*Comparison at Agincourt.*

On July 9, 1908, a series of readings were taken with magnet 10, Tesdorpf magnetometer 1977, magnet erect, and magnet inverted.

|   |            |
|---|------------|
| The resulting declination July 9, at 14 <sup>h</sup> 33 <sup>m</sup> was. . . . . | 6° 01'.4 W |
| Observatory standard magnetometer. . . . .  | 5° 57'.6   |
| Similarly on July 11 at 14 <sup>h</sup> 05 <sup>m</sup> , Tesdorpf. . . . .       | 6° 03'.1   |
| Observatory. . . . .  | 6° 00'.4   |
| Mean difference O - T. . . . .  | — 3'.2     |

Hence west declinations as observed with the Tesdorpf instrument must be numerically decreased by 3'.2, and east declinations increased numerically by the same amount.

For horizontal intensity the following comparisons were obtained:—

|  |                         |
|--|-------------------------|
| July 10 at 14 <sup>h</sup> 05 <sup>m</sup> , Tesdorpf. . . . . | -16400 in C.G.S. units. |
| “ 14 <sup>h</sup> 05 <sup>m</sup> , Observatory. . . . .       | -16387 “                |
| “ 16 <sup>h</sup> 33 <sup>m</sup> , Tesdorpf. . . . .          | -16391 “                |
| “ 16 <sup>h</sup> 33 <sup>m</sup> , Observatory. . . . .       | -16379 “                |
| July 11 at 10 <sup>h</sup> 23 <sup>m</sup> , Tesdorpf. . . . . | -16356 “                |
| “ 10 <sup>h</sup> 23 <sup>m</sup> , Observatory. . . . .       | -16349 “                |
| “ 11 <sup>h</sup> 44 <sup>m</sup> , Tesdorpf. . . . .          | -16365 “                |
| “ 11 <sup>h</sup> 44 <sup>m</sup> , Observatory. . . . .       | -16357 “                |
| Mean difference, O - T. . . . .                                | -00010                  |

This is equivalent to -00061 *H*, which is the quantity to be deducted from observed values of *H*. In figures 2, 3, 4, are shown the observations made for ascertaining the effect, if any, of the electric car service already referred to. The smooth curves drawn exhibit the diurnal variation clearly, showing the hours of the day when it changes most rapidly.

It will be seen that for April 24, 1909, the range was nearly 17 minutes of arc.

In figure 5, is shown a curve based upon the one of the preceding date. This curve represents the actual line that would be run by a surveyor with a compass in trying to lay down a true N.-S. line, starting at 7 a.m. of that day, getting half-mile sights, then resetting at hour intervals, always with the same magnetic reading of the compass without getting back-sights on the preceding station. The scale of offsets is much exaggerated in the figure.

The result would be that after running six miles by evening, he would be 104 links or about 69 feet west of the line on which he started in the morning.

This shows the theoretical inaccuracy of a compass line due to diurnal variation alone. Of course with the ordinary surveyor's compass it is not possible to read to single minutes, far less to fractions thereof such as enter into the above curve. But the point is, one cannot get away from the important effect of diurnal variation, though it be masked by larger errors of reading. When compass lines are, or were, run in the open a fairly straight line could be run by using back-sights or simply 'picketing' the line, but this condition was rarely the case; the most of the compass lines were run through the woods, the trees being 'blazed' along the line. those on the line were 'notched' and left standing, and the compass simply put on the other side of the obstruction and the line continued on the same bearing as near as it was possible to read the needle.

The actual magnetic bearings of the astronomic north and south line at Ottawa on that day were:

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| Hour.                           | Bearing.    | Offset at end of each course from true N.-S. line of first course. |
|---------------------------------|-------------|--|
| 7 <sup>h</sup> (a.m.) . . . . . | 12° 52'.4 W | 0.0 links.   |
| 8 . . . . .                     | 51.2        | 1.4 "  |
| 9 . . . . .                     | 51.0        | 3.0 "  |
| 10 . . . . .                    | 54.8        | 0.2 "  |
| 11 . . . . .                    | 59.0        | 7.7 "  |
| 12 . . . . .                    | 13° 03'.0   | 19.8 "   |
| 13 . . . . .                    | 6.0         | 35.5 "   |
| 14 . . . . .                    | 7.4         | 52.8 "   |
| 15 . . . . .                    | 6.4         | 69.5 "   |
| 16 . . . . .                    | 4.4         | 83.2 "   |
| 17 . . . . .                    | 2.4         | 95.0 "   |
| 18 . . . . .                    | 0.5         | 104.4 "  |

For the coming season it is intended to send the observer along the northern shore of the St. Lawrence from Quebec eastward to Blanc Sablon, near the western entrance of the strait of Belle Isle. The data from this territory are very meagre, so that the magnetic elements to be derived on this stretch of about 750 miles will be of particular value.

The accompanying map shows the position of the various stations given in the table, and the direction of the magnetic meridians at the respective stations or places.

GRAVITY.

During the past season no member of the staff was available for making gravity observations.

I have the honour to be, sir,

Your obedient servant

OTTO KLOTZ.







FIG. 1. Magnetic Hut, Ottawa.



Diurnal Variation Curve

— Ottawa

— April 24 1909

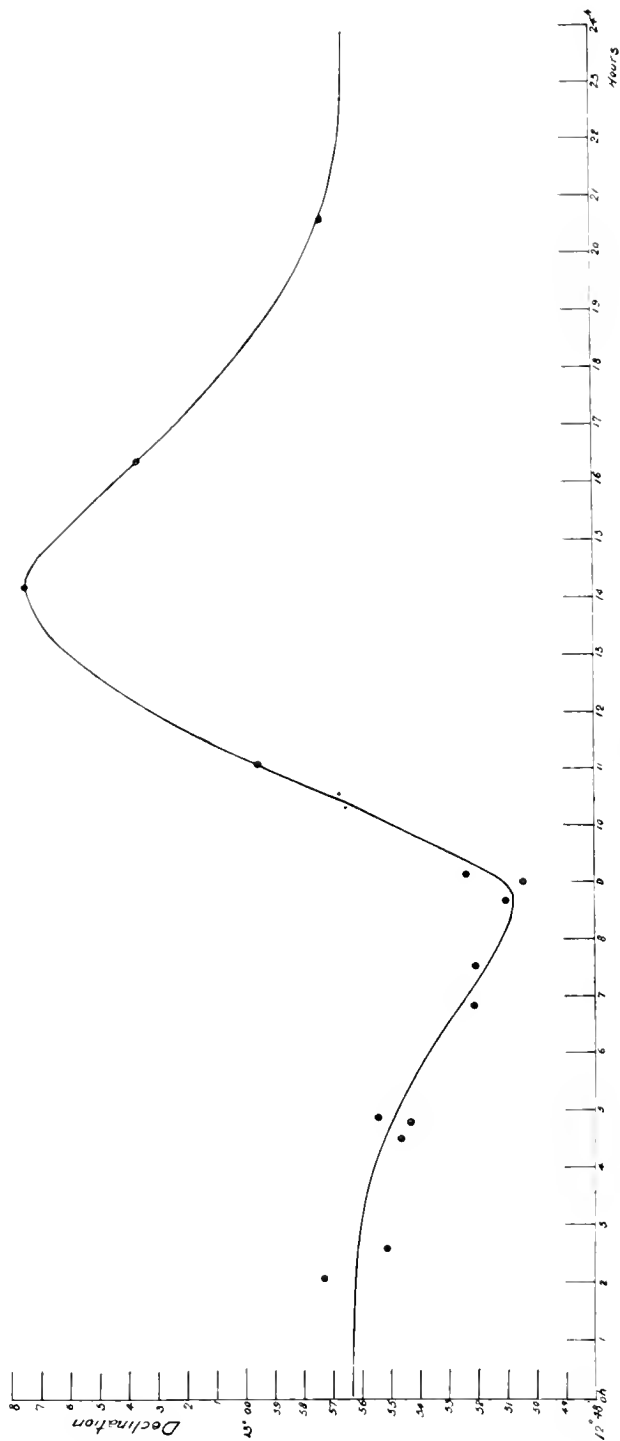


FIG. 2.



Diurnal Variation Curve  
Ottawa  
April 29 1909

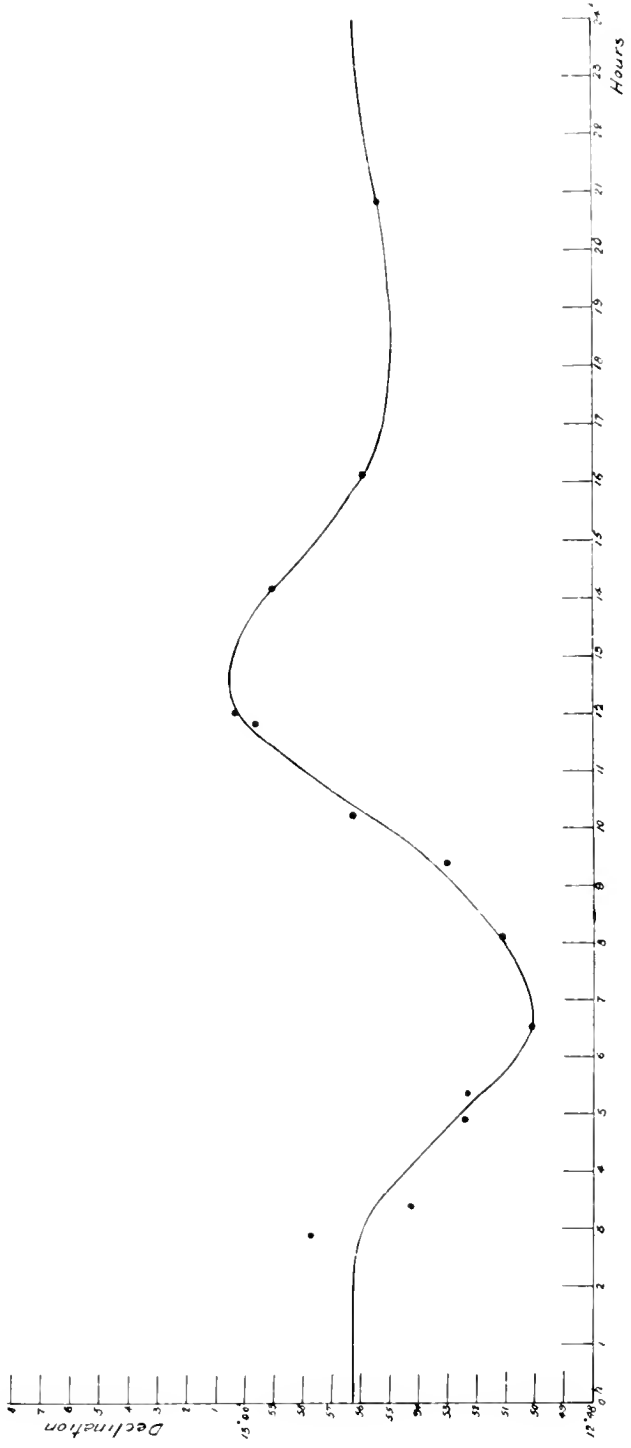


FIG. 3.



Diurnal Variation Curve  
Ottawa  
May 7 1909

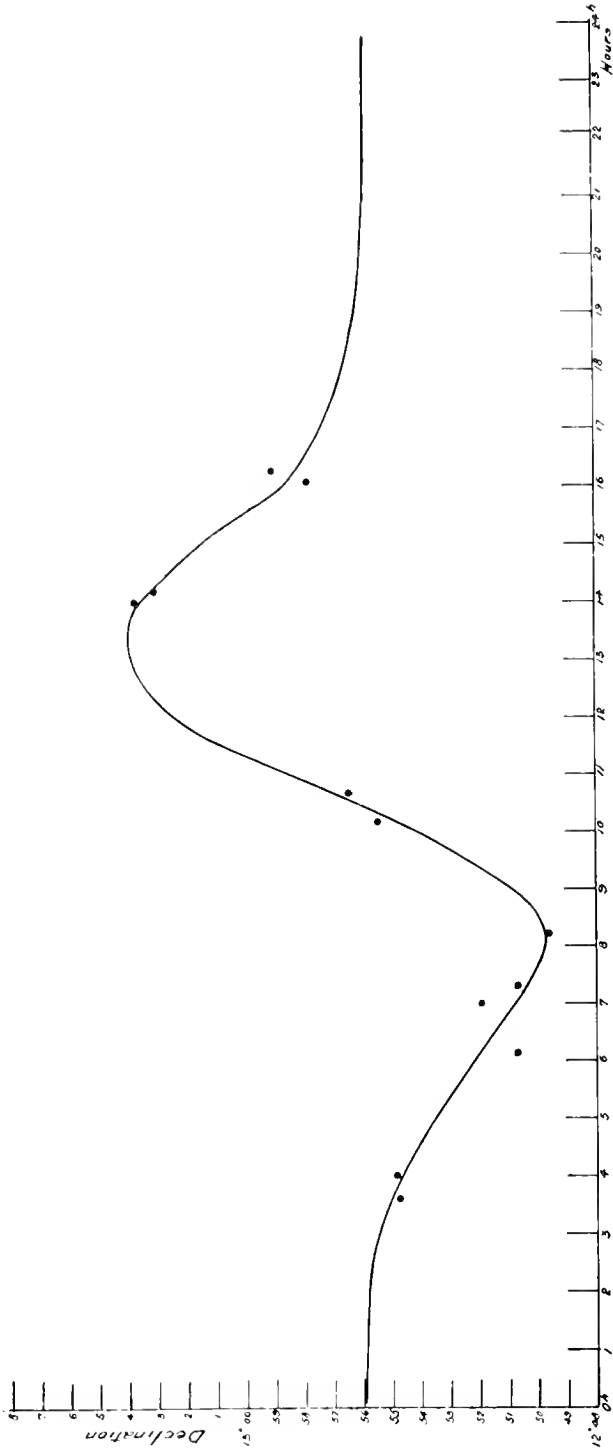
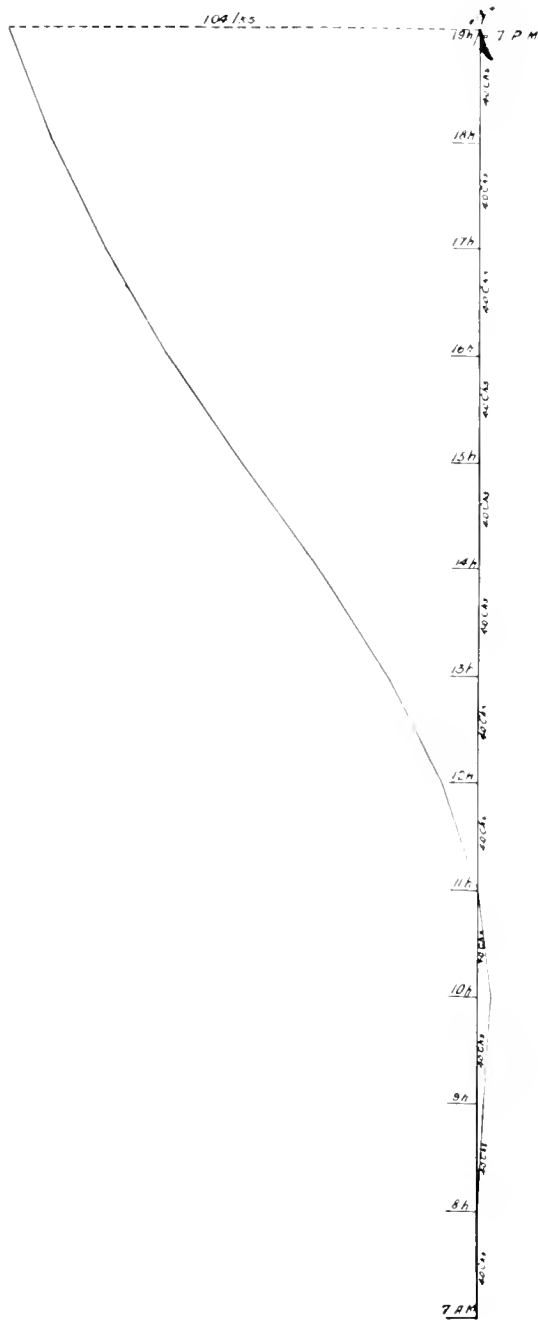


FIG. 4.





Survey Curve





**APPENDIX 2.**

REPORT OF THE CHIEF ASTRONOMER, 1909.

---

**ASTROPHYSICAL WORK**

BY

J. S. PLASKETT, B.A.

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## APPENDIX 2.

## ASTROPHYSICAL WORK BY J. S. PLASKETT, B.A.

OTTAWA, March 31, 1909.

W. F. KING, C.M.G., LL.D.,  
Chief Astronomer,  
Department of the Interior,  
Ottawa.

SIR,—I have the honour to submit the following report upon the work carried on in the Astrophysical Department and in the other departments of the work of the Observatory under my direction during the past year.

It gives me pleasure to report satisfactory progress in all lines and to state that the work accomplished both in quality and quantity shows gratifying improvement over the records of previous years. As in previous years also it has been found necessary to spend considerable time in preparatory work, in testing, adjusting, and perfecting the instruments and appliances used, and in experimenting to determine the best methods of procedure. Although the time spent on such work necessarily diminishes the quantity of routine work accomplished, it is in my opinion time well spent, if through such investigations and experiments we are in a position to do a larger quantity of more accurate work. Consequently, much of my time during the past year has been devoted to investigations bearing on improvements in instruments and methods, of which full details will be given later.

It gives me much pleasure to be able to speak in the highest terms of the very satisfactory work done by my assistants, Messrs. Harper, Motherwell, DeLury, Cannon and Parker.

As heretofore, the principal work has been the determination of the radial velocities of stars by means of the spectroscope, and in this work observations have been chiefly confined to known spectroscopic binaries for the determination of the elements of their orbits. However, observations on some stars with early type spectra have also been secured during times when sufficient binaries have not been available, and in measuring up the plates we have found the velocities of four of these stars to be variable;  $\delta$  Herculis,  $\gamma$  Aquarii,  $\iota$  Andromedæ,  $\xi$  Persæi. The two latter, it has since been learned, had been previously found variable at the Yerkes Observatory, but not published, so that our discovery was independent.

The elements of the orbits of five spectroscopic binaries have been obtained, least squares corrections being applied in every case. The stars are  $\theta$  Aquilæ,  $\alpha$  Coronæ Borealis,  $\eta$  Boötis,  $\epsilon$  Herculis,  $\beta$  Orionis. These stars will be discussed in detail below, but it may be of interest to mention that only in one case,  $\eta$  Boötis, have the observations been entirely satisfied by velocity curves due to simple elliptic orbits. In  $\theta$  Aquilæ and  $\epsilon$  Herculis a secondary disturbance due possibly to a third body, has been present. In  $\alpha$  Coronæ Borealis the elements deduced from the hydrogen lines and the calcium,  $K$ , line differ from those obtained from the magnesium  $\lambda 4481.4$ , while in  $\beta$  Orionis the amplitude of the velocity seems to be variable. This latter is of especial interest on account of the measures made at Yerkes and Lick Observatories showing its velocity to be constant within the apparent errors of observation.

Besides the binaries above, whose orbits have been determined, there are twelve others under observation, on three or four of which the work is well advanced. On the remainder, however, a considerable number of observations are still required. About 90 per cent of the binaries observed here are stars of early type, in the majority of which the lines in the spectra are broad and diffuse, in some cases unsymmetrically so, and consequently difficult of measurement. In such cases the agreement among the lines in a plate is poor and the error of measurement is high, the probable errors of single plates being as great as 7km. per second in some cases. It is evident that, unless there is a large range of velocity, the elements of the orbits of such stars are subject to considerable uncertainty, and indeed in several cases the star has had to be abandoned on this account after considerable work had been done on it.

The instrumental equipment for this work has been increased since my last report by the addition of a new single-prism spectrograph designed by myself, and constructed, except the optical parts, entirely in our own workshop. Owing to press of repair and other work it was not completed and put into commission until about the first of March, but it has fulfilled all expectations both as regards shortening of exposure time and in respect to its stability and freedom from flexure. The displacement of the spectrum lines produced by a revolution of  $180^\circ$ , this producing the maximum amount of flexure, is quite unmeasurable and is not even certainly visible under high power magnification; there is no question but that it is the most stable single-prism spectrograph ever constructed. The difference between it and the previous instrument, which was for its type a rigid example, is very marked, the displacement in the early instrument being equivalent to a velocity of over 100km. per second.

My investigation on the fields given by different types of camera objectives for spectrographs was completed, and a concise account of the performance of all the objectives tested will be given below and will also appear in the *Astrophysical Journal* in May. Since my previous report a new single material Brashear objective for the new single prism spectrograph has been received and tested. Its angular aperture is about 50 per cent greater than the original one and when received, owing to the greater difficulty in correction, it had a small amount of positive aberration. By the kindness and through the skill of Mr. McDowell this aberration was finally removed and the objective is now practically perfect for its purpose. A special short focus objective by Ross has also been received and tested, giving beautiful definition and a fairly flat field. Thus, the requirements for all types of camera objectives have been successfully met, and there are now available suitable objectives for all classes of radial velocity and other spectroscopic work.

The investigation on the effect of increasing the slit width on the errors of measurement in radial velocity work has been continued with the two different dispersions now available. The new single-prism spectrograph and a short focus objective with the three prism instrument have been tested, giving results that bear out and extend those previously obtained. It is shown that, so far as early type spectra are concerned, both accidental and systematic errors approach a minimum value for a slit 0.051mm. wide and that the use of a narrower slit, instead of increasing the accuracy as has generally been supposed, has to a certain degree the opposite effect, to say nothing of the proportional increase of exposure required. A detailed report of this work will be postponed to allow it to be finally completed.

In presenting the work on radial velocities and allied investigations in detail, I have adopted the same plan as last year, of having each observer give the details and results of the work he has been engaged on. Consequently, below will be found, besides my own remarks on radial velocities in general, my description of the new spectrograph, the investigations on camera objectives and on the effect of slit width, and the orbit of  $\beta$  Orionis, the orbits of  $\theta$  Aquilæ,  $\eta$  Boötis and  $\epsilon$  Herculis by Mr. Harper, and the orbit of  $a$  Coronæ Borealis by Mr. Cannon. Mr. Parker, the third observer in radial velocity work, besides measuring many miscellaneous plates, spent



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a great deal of time on the binary  $\tau$  Tauri, but owing to difficulties due to causes outlined above was unable to obtain a satisfactory orbit and further observations next season will probably be necessary.

Work with the coelostat telescope in spectroscopic investigations of the sun has made satisfactory progress, although not as much has been accomplished as we had hoped. This has been due to various unavoidable constructional delays in having the 23-foot spectrograph and its attachments completed, to a long delay while the solar research laboratory was torn up for the installation of underground pipes and an electric pump for draining the transit house piers, and to a very thorough investigation of some peculiar properties in the plane grating used as the dispersion piece in the spectrograph. This investigation, which is fully described by Dr. DeLury below, showed that only by masking part of the grating could even fair definition be secured, while the best definition is necessary for accurate results in the determination of the solar rotation. A number of plates for this purpose have been secured and some preliminary measures by Dr. DeLury will be given. An illustrated description of the coelostat telescope and mechanism will be given by myself, and a description of the spectrograph and attachments by Dr. DeLury.

Mr. Motherwell has used the equatorial on three half nights per week in micrometric measures of double stars and has obtained a number of good measures, although his, as well as all other work with the telescope, has been much handicapped by the exceptionally poor observing weather of last fall and early winter. For nearly four months, smoke and cloud prevented almost all observations. This was especially unfortunate on account of the presence of Morehouse's comet, an especially interesting object, photographically, which this bad weather prevented from being photographed here more than half a dozen times. However, Mr. Motherwell will give an account in Appendix D of the double star measures obtained, of the occultations of stars by the moon observed, and of the photographs of the comet secured.

A full account of an interesting and useful investigation by Mr. Motherwell on the aberration of the 8" Brashear Photographic Doublet, used in making the comet pictures, will be given. When this instrument was first tested by me, soon after the Observatory was completed, it was found to give halos around the stars of medium intensity, while in the brighter stars this halo had become so fully exposed as to make images of uniform intensity and of large diameter. This difficulty I ascribed to spherical aberration, but this diagnosis was opposed by the makers of the lens.

I suggested to Mr. Motherwell as a suitable and useful subject for investigation to determine by Hartmann's method of extra-focal exposures the amount of spherical aberration present. His thorough tests showed the lens to have negative aberration to the extent of about 3.5mm., which in our opinion was quite sufficient to account for the halo observed. A suggestion of Mr. McDowell that it was due to chromatic aberration was found by Mr. Motherwell not to be the case. The matter remained in abeyance for some time, when on a further suggestion from Prof. Hastings the separation of the elements of the front component was changed to remove the halo, supposedly a 'ghost' due to internal reflections. However, a test showed no improvement on the original positions in the slight change proposed. Further correspondence with Mr. McDowell resulted in a suggestion from him to increase the separation by about 2mm., which would practically remove the aberration. On this being done and the distance adjusted so that the aberration was removed, the halo disappeared which was a striking confirmation of our contention that it was caused by aberration. A recent letter from Mr. McDowell admits that we were right as he had proved by refiguring a lens giving a similar halo.

In consequence, the objective will be sent to Alleghney to have this aberration removed and with its already very flat field we should have an unequalled star camera. In this regard, I would urge upon you the desirability of supplying the camera with a separate mounting. Its attachment to the equatorial telescope results in seriously

limiting its usefulness; for when star photographs are being made, no work, other than the guiding, can be done with the equatorial. A separate mounting, however, would enable the two to be used independently and much more use could be made of the camera than is possible at present.

The quantity of repair and other work has increased so greatly, that the two mechanics, Mr. Mackey and Mr. Lucas, the latter having been appointed since my last report, have not been able to keep up with all the work required. Repairs and minor alterations in the field instruments used in the Geodetic and Boundary Surveys, occupy about one-half their time, leaving the remainder for new work. The new single-prism spectrograph, the mechanical parts of the solar 23-foot focus spectrograph, and new hardened steel pivots on the meridian circle are the principal pieces of work accomplished. Besides these are numerous smaller pieces of work. Scarcely a day passes that some work does not come in.

The equipment of the machine shop has been increased by a 14 inch by 7 foot Hendry Norton lathe, which is installed and in use. With two lathes there is now no possibility of delaying work for lack of tools. The lathe is the tool most used in machine work and frequently cases occurred where both men required the lathe at the same time; in consequence the work could not be done to the best advantage. The workshop is too small for the tools and the amount of work done, and moreover the light in it is not of the best. It is desirable that, as soon as possible, provision be made for a suitable workshop above ground with ample room and light. The necessity and economy of a suitably equipped workshop for the Observatory are so evident, and the probability of an increase in its capacity being required is so great, as to justify the question of a more suitable location than the present one being carefully considered.

The field instruments and others of a portable nature have been most carefully looked after by Mr. Motherwell, who has kept a careful record of their movements. This work has become, with the increase in the staff and in the number of instruments, one of considerable labour and trouble and takes much of his time in the spring and fall.

The Saturday open nights of the telescope for the public continue to be well patronized, the average attendance on fine nights being upwards of fifty, and much intelligent interest is manifested by many of the visitors in astronomy. This interest is further fostered by the papers presented at the evening meetings of the Royal Astronomical Society of Canada, of which the majority are given by officers of the Observatory. It may not be amiss here to refer also to the value of the work done by the members of the Observatory staff in the afternoon or technical lectures given alternately with the evening ones. These lectures and papers presenting in most cases original work in different lines of astronomy have been of great value, not only in keeping us acquainted with each other's work but also in encouraging researches along original lines which have been frequently of distinct value to science.

The following papers by members of the staff of the Astrophysical Division have been published since the date of the last report:—

1. The spectroscopic Binary  $\iota$  Orionis, by J. S. Plaskett and W. E. Harper, *Astrophysical Journal* XXVII., p. 272, May, 1908.
2. Effect of increasing the slit-width upon the accuracy of Radial Velocity Determinations, by J. S. Plaskett, *Astrophysical Journal* XXVIII., p. 259, Nov., 1908.
3. The spectroscopic Binary  $\psi$  Orionis, by J. S. Plaskett, *Astrophysical Journal* XXVIII., p. 266, November, 1908.
4. The Orbit of  $\iota$  Orionis, by J. S. Plaskett, *Astrophysical Journal* XXVIII., p. 274, November, 1908.
5. The Astronomical and Astrophysical Society of America, by J. S. Plaskett, *Journal of the Royal Astronomical Society of Canada* II., p. 255, September-October, 1908.

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6. The Reduction of Cadmium by Mercury and the Electro-Motive Force of Cadmium Amalgam, by R. E. DeLury and G. A. Hulett, *Journal of the American Chemical Society*, volume 30, No. 12, p. 1805, December, 1908.

7. Comet 1908 (Morchouse), by R. M. Motherwell, *Journal of the Royal Astronomical Society of Canada III.*, p. 28, January-February, 1909.

8. The Orbit of  $\beta$  Aquilæ, by W. E. Harper, *Journal of the Royal Astronomical Society of Canada VII.*, p. 87, March-April, 1909.

Besides the above the following papers are to appear shortly, the work on them having been completed and sent to the publishers:—

9. Camera Objectives for Spectrographs, by J. S. Plaskett, *Astrophysical Journal*, May, 1909.

10. The Spectroscopic Binary  $\beta$  Orionis, by J. S. Plaskett, *Astrophysical Journal*, July, 1909.

11. The design of Spectrographs, by J. S. Plaskett, *Journal of the Astronomical Society of Canada*, May-June, 1909.

In addition to the above the Astrophysical Division have sent in the titles of the following seven papers to be read before the Royal Society of Canada at their meeting, May 25, 1909:—

12. A new Single Prism Spectrograph, by J. S. Plaskett.

13. Slit width and Errors of Measurement in Radial Velocity Determinations, by J. S. Plaskett.

14. The spectroscopic Binary  $\beta$  Orionis, by J. S. Plaskett.

15. The System of  $\epsilon$  Herculis, by W. E. Harper.

16. Aberration of a Stellar Camera Objective, by R. M. Motherwell.

17. Convection and Stellar Variation, R. E. DeLury.

18. The Orbit of  $\alpha$  Coronæ Borealis, by J. B. Cannon.

In general the work represented by these papers will appear in detail below, arranged sometimes in a little different form, and including as a rule the whole of the original measurements and data which were abbreviated or left out in the published papers.

## THE SPECTROGRAPHS.

During the year just passed the Ottawa spectrograph, illustrated and described in the 1907 report, has been used almost entirely, the new single-prism spectrograph not having been ready for service until about March 1, 1909. The former instrument has been used mostly in the single-prism form, the three prisms having been used only for some plates of  $\beta$  Orionis and a few others. The spectrograph has not been changed in any way since the last report, and its performance has continued satisfactory. Nothing further need be added about this instrument, except that towards the close of the year the Zeiss Tessar objective of 300mm. focus, referred to in the last report, was temporarily mounted for the purpose of continuing the tests on the effect of slit-width on errors of setting so far as applies to a dispersion of three prisms with a short focus camera. This mount will be placed in a permanent form as soon as time can be found in the workshop, and used on solar type binaries too faint to be obtained with the long focus camera.

Before proceeding to describe the new single-prism spectrograph, which was briefly referred to in my last report, it has seemed desirable to enter more fully than was there done into the principles on which its design was based, and for this purpose I can not do better than give here a paper on 'The Design of Spectrographs,' which I read at an afternoon technical meeting on May 25, 1908, and which will appear in the May-June number of the *Journal of the Royal Astronomical Society of Canada*.

## THE DESIGN OF SPECTROGRAPHS FOR RADIAL VELOCITY DETERMINATIONS.

*Read before R.A.S.C., May 28, 1908.*

The subject of spectroscopy is so broad that one can not hope in a single paper to do more than touch upon a single aspect of it, and, even then, one must further limit his treatment to a particular application of this phase. Consequently, I propose to present some considerations bearing upon the design of spectrographs suitable for the accurate determination of stellar radial velocities. This branch of spectroscopy is comparatively new and is still probably only in the experimental and tentative stage. The present practice in this line has, however, reached a certain uniformity and the general theoretical principles governing the design of spectroscopes may be applied to the case under consideration, modified, of course, in many ways by the experience of the various observers. The question is one of a judicious combination of theory and experience, and I propose to present my own views, founded, of course, on theoretical considerations, but modified partly by the practice of other spectroscopists, partly by my own experience in the work and by the results of special investigations bearing on the most suitable form and dimensions of the instrument.

The determination of the radial velocities of stars by means of the spectroscope is one of the most exacting of astronomical investigations, and requires the closest attention to all details to ensure accurate values. This will be more readily recognized when the smallness of the displacement of the spectral lines on which the velocity depends is known. Thus, in the Ottawa Spectrograph a velocity of 20km. per second, which is greater than the average velocity of the stars, causes a displacement at  $H\gamma$ , the centre of the measurable range, of about  $\frac{1}{2700}$  inch for the single-prism, and about  $\frac{1}{900}$  inch for the three-prism form of the instrument. The accidental errors arising in the measurement of this displacement, in spectra with good lines, are, however, not so much to be feared as systematic displacements of the lines as a whole, of which no evidence is given in the measurements, caused by flexure of the parts of the spectrograph, by temperature changes in the prisms and lenses and also in the metal frame, by faulty adjustment of the focal positions of camera and collimator, as well as by numerous other causes. Some idea of the magnitudes of these displacements may be gained from the following figures. An hour's exposure in one of the modern spectrographs introduces flexure displacement equivalent, in some positions of the telescope, to a velocity of 10km. per second. A change of temperature of  $1^{\circ}\text{C}$ . in the prism displaces the lines by about 20km., which may be increased further by the expansion of the metal parts. An inaccuracy in the focal setting of the camera of only 0.1 mm.  $\frac{1}{250}$  inch, may, when combined with poor guiding, cause a displacement of about 5km. It does not follow that such displacements necessarily cause a corresponding error in the velocity as they may be compensated for, partially at any rate, by a similar displacement of the comparison lines. But the possibility remains, and inaccurate results can only be prevented by constant and careful attention to all details. It becomes, therefore, a question of equally great importance with proportioning the optical parts to give accurately measurable spectra in the shortest possible exposure time, to so design the whole instrument that systematic errors due to the above or other causes may be provided for and eliminated as far as possible.

The design of a spectrograph may be most conveniently attacked under two separate headings:

1. The character and proportions of the optical parts.
2. The mechanical connection of these parts into a symmetrical and stable whole, with suitable auxiliary devices for controlling the temperature, applying comparison, &c.

The Optical Parts.

‘Up to the present, prisms of dense flint glass have been the sole dispersing medium used for radial velocity work. Gratings, so useful in other branches of spectroscopy, have not yet been applied in this work, chiefly on account of the division of the incident pencil into a number of spectra with the consequent loss of light, and also on account of the difficulty of maintaining their position invariable without distorting the surface. Prisms have very decided advantages over gratings in this respect as, when set at minimum deviation, a small angular rotation of the prism will scarcely displace the spectrum lines, while with a grating the angular displacement of the lines is double that of the prism. The optical parts of a spectrograph are then:—1. The slit, whose width is usually between 0.025 and 0.051mm., one and two thousandths of an inch, on which the star image is condensed by the telescope. 2. The collimating lens placed at its focal distance from the slit and consequently rendering the incident pencil parallel. 3. The prism or prisms placed at minimum deviation for some particular wave-length usually near  $H\gamma$ . 4. The camera lens which forms an image of the spectrum on the photographic plate.

‘As the terms dispersion, resolving power, purity, &c., will be frequently used and as the prism angle, thickness of base, &c., require computing, it seems preferable to give here a short synopsis of the theory involved and the formulæ used, particularly as these are not readily available in a suitable form or collected together in one place.

‘When a pencil of parallel white light is incident upon a prism, the direction is changed, the light is deviated, and it is also decomposed into its constituent colours forming a spectrum, the wave-lengths of the light giving rise to these colour-sensations, diminishing as you go from red to violet. The fundamental formula determining the direction after refraction is,  $i$  being the angle of incidence,  $r$  of refraction,

$$\sin i = \mu \sin r.$$

$\mu$  is the index of refraction which varies for different materials and for different wave-lengths in the same material, increasing as the wave length diminishes. In all spectroscopes the prisms are used at the position of minimum deviation, which, it may be easily shown, requires the angles of incidence and emergence to be equal. The discussion will therefore be confined to this particular case, resulting in a considerable simplification.

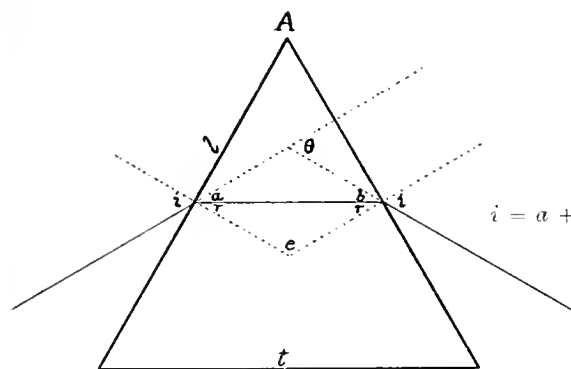


Fig. 1.

$$A + e = 180^\circ$$

$$e + 2r = 180^\circ$$

$$\therefore r = \frac{A}{2}$$

$$\theta = a + b; \quad a = b,$$

$$\therefore a = \frac{\theta}{2}.$$

$$i = a + r = \frac{A + \theta}{2}, \text{ and as } \sin i = \mu \sin r,$$

$$\mu = \frac{\sin \frac{A + \theta}{2}}{\sin \frac{A}{2}}.$$

If  $a$  is aperture of incident pencil just filling prism,

$$l = a \sec i.$$

$$t = 2 l \sin \frac{A}{2} = 2 a \sec i \sin \frac{A}{2}.$$

If  $\theta$  the deviation and  $\mu$  the index are given to find  $A$  or the angle of the prism,

$$\sin \frac{A + \theta}{2} = \mu \sin \frac{A}{2} \text{ and reducing and simplifying}$$

$$A = 2 \sin^{-1} \frac{\sin \frac{\theta}{2}}{\sqrt{\sin^2 \frac{\theta}{2} + \left( \mu - \cos \frac{\theta}{2} \right)^2}}$$

The dispersion of a prism is usually defined as the ratio of the change in deviation to the change in wave length or  $\frac{d\theta}{d\lambda}$ . As the deviation varies with the index of refraction and as the latter varies with the wave length we may put

$$\frac{d\theta}{d\lambda} = \frac{d\theta}{d\mu} \cdot \frac{d\mu}{d\lambda}, \text{ but}$$

$$\mu = \frac{\sin \frac{A + \theta}{2}}{\sin \frac{A}{2}}$$

$$\therefore \frac{d\theta}{d\mu} = \frac{2 \sin \frac{A}{2}}{\cos \frac{A + \theta}{2}} = \frac{2 \sin \frac{A}{2}}{\cos i}$$

$$= \frac{2 \sin \frac{A}{2}}{1 - \sin^2 i} = \frac{2 \sin \frac{A}{2}}{\sqrt{1 - \mu^2 \sin^2 \frac{A}{2}}}$$

$$\text{also } \frac{d\theta}{d\mu} = \frac{2 \sin i}{\frac{\mu}{\cos i}} = \frac{2}{\mu} \tan i.$$

To obtain  $\frac{d\mu}{d\lambda}$  we require a relation between  $\lambda$  and  $\mu$ . The simplest is obtained from Hartmann's interpolation formula.

$$\mu = \mu_0 + \frac{c}{\lambda - \lambda_0}$$

$$\therefore \frac{d\mu}{d\lambda} = - \frac{c}{(\lambda - \lambda_0)^2} \text{ and consequently}$$

$$\frac{d\theta}{d\lambda} = \frac{d\theta}{d\mu} \cdot \frac{d\mu}{d\lambda} = - \frac{c}{(\lambda - \lambda_0)^2} \cdot \frac{2 \sin \frac{A}{2}}{\sqrt{1 - \mu^2 \sin^2 \frac{A}{2}}}$$

Let us now consider resolving power or the ability of the prism to separate lines close together in the spectrum. Lord Rayleigh has shown, in the case of the image of

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an infinitely narrow slit produced at the focus of a telescope lens, that the linear distance  $\xi$  of the first diffraction minimum from the principal maximum is given by the equation.

$$\frac{a \xi}{m \lambda f} = 1,$$

where  $a$  is the aperture and  $f$  the focus of the lens and  $m$  is a constant, 1.0 for rectangular and 1.2 for circular apertures.

$$\frac{\xi}{f} = \frac{m \lambda}{a}$$

$\frac{\xi}{f}$  is then the least angular distance at which two rays can be seen separated. Calling the angle  $d\theta$  we have

$$d\theta = \frac{m \lambda}{a}$$

For the case of a prism we have

$$a = t \cos i, \quad t = 2l \sin \frac{A}{2}$$

$$\therefore \frac{t}{a} = \frac{2 \sin \frac{A}{2}}{\cos i} = \frac{d\theta}{d\mu}$$

Combining we get the minimum condition of resolution

$$t = \frac{m \lambda}{d\mu}$$

Again, omitting the constant  $m$ , we have

$$d\theta = \frac{t d\mu}{a} = \frac{\lambda}{a},$$

and multiplying by  $\frac{a}{d\lambda}$  we get

$$a \frac{d\theta}{d\lambda} = t \frac{d\mu}{d\lambda} = \frac{\lambda}{d\lambda}$$

where  $\frac{\lambda}{d\lambda}$  is the minimum value which permits resolution of close lines.  $\frac{\lambda}{d\lambda}$  or the ratio between the mean wave length of a pair of lines which can just be resolved in a spectroscope and the difference in wave length between the two components is called the resolving power of the spectroscope and is usually designated by the letter  $R$ .

‘The linear dispersion  $\frac{ds}{d\lambda}$  where  $f$  = focal length of camera is

$$\frac{ds}{d\lambda} = f \cdot \frac{d\theta}{d\lambda} = f \cdot \frac{R}{a}$$

‘The resolving power  $R$  refers to infinitely narrow lines through an infinitely narrow slit. When, as necessarily occurs in practice, neither of these two conditions holds, we speak of the purity of the spectrum or the practical resolving power for wide slits. Schuster has given a simple expression for the purity which is always a fraction of the theoretical resolving power  $R$ . This expression has been elaborated by Wadsworth

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and later still Schuster has given tables for determining the purity. But as no appreciable error will be introduced in the relative values used in this work, it has seemed preferable to adhere to the simple form. If  $d$  = slit width and  $\psi$  = angular aperture of the collimator =  $\frac{a}{f}$ , the Purity  $P = \frac{\lambda}{d\psi + \lambda} \cdot R$ .

We have now obtained all the formulæ necessary to compute the data for any optical system and to compare the efficiency of different forms of spectroscopes. To take a concrete case, which is more applicable for our purpose than a general discussion, I propose to consider the question of the most suitable aperture to be given a single-prism spectrograph which is being constructed for the Dominion Observatory. The present spectrograph, which is arranged to be used with either one or three prisms, has a collimator of 35mm. aperture, 525mm. focus and two cameras, one for each form of 525mm. focus. It performs excellently for both purposes, but when, as often happens, both single and three prisms are required on the same night, the change from one form to the other is somewhat tedious, requiring 15 or 20 minutes, and moreover, what is far more important, such change involves uncertainties as to the temperature conditions of the optical parts and therefore corresponding uncertainties as to the accuracy of the velocities obtained.

In order to fill the collimator lens completely with star light its aperture ratio  $\frac{a}{f}$  must be the same as that of the equatorial. The aperture ratio of the Ottawa telescope is 1 to 15, consequently the focal length of the collimator must be 15 times the aperture. This aperture is limited on the lower side by the condition that sufficient purity must be obtained, purity being proportional to the aperture at a practicable width of slit, to so separate lines and blends of lines that sufficiently accurate identifications of lines and the true wave lengths of blends may be obtained. It is limited on the upper side by the difficulty of obtaining homogeneous prisms of large size, by the increased absorption of such prisms, and by the increased size and weight of the instrument. In all the spectrographs used in radial velocity work the apertures lie between 30 and 51mm., and these seem to be about the practical limits. It remains to determine the most suitable.

The basis of the discussion\* rests upon the results obtained for the effective diameter of the star image given in my paper on 'The Star Image in Spectroscopic Work,' No. II, which was read here last fall and published in the *Astrophysical Journal*, March, 1908. The results of a number of experiments, photographs of star images, spectra and trails, went to show that only very rarely is the effective diameter of the image less than 2 secs. of arc (about 0.055mm.) at the focus of the refractor. Generally the diameters of images and the widths of spectra and trails are considerably greater, increasing to over 0.1mm. with longer exposures. As the theoretical diameter of the central disc is only 0.57" (about 0.015mm.) and, as the condensing system of visual objective and photographic correcting lens is practically perfect, the enlargement in diameter is undoubtedly due to atmospheric disturbances. These consist probably partly of a blurring or spreading out of the central disc and partly of small displacements in all directions from its mean position. In consequence there results considerable loss of light at the slit jaws with the widths usually employed, and further experiments showed that the proportion transmitted varied almost directly with the width until this reached 3 or 4 secs. I reproduce below part of the table for slit transmission given in the paper referred to:—

\* An able discussion of this subject on somewhat similar lines, to which I am much indebted, has been given by Newall (*M. N.* 65, p. 608).



SLIT TRANSMISSION.

| Slit Width. |               | Comparative exposure for equal intensity of spectrum. |                                    |
|-------------|---------------|---|------------------------------------|
| Linear mm.  | Angular secs. | Observed.   | Corrected for loss by diffraction. |
| 0.025       | 0.91          | 100   | 100                                |
| 0.051       | 1.82          | 40  | 50                                 |
| 0.076       | 2.73          | 27  | 35                                 |
| 0.102       | 3.64          | 25  | 32                                 |

'This table shows that if the slit width can be increased the exposure is proportionally diminished, double the slit width halve the exposure, which means, of course, an increase in the output and in the practical range of the equipment. But on the other hand, a widening of the slit, other conditions remaining unchanged, decreases the accuracy of measurement of the resulting spectra. This loss of accuracy is due to two causes: first, diminished purity rendering uncertain identifications and wave lengths of blends; second, increased diffuseness of the spectral lines rendering measurements more difficult. We will take up these two considerations separately and find under what conditions the slit may be widened without loss of accuracy.

The equation for purity of spectrum,  $P = \frac{\lambda}{d\psi + \lambda} \cdot R$ , shows that the purity is almost proportionally diminished as the slit width is increased as  $d\psi$  is, even for slit 0.025mm., nearly ten times  $\lambda$ . To increase the purity of a spectrum only two courses are open—to diminish the slit width or increase the resolving power. As we wish to widen the slit the resolving power of the spectroscope must be increased, which may be done in three ways.

1. By increasing the aperture of the prism or prisms  $R = \frac{\lambda}{d\lambda} = a \frac{d\theta}{d\lambda}$  or  $R$  varies directly with the aperture.
2. By increasing the number of prisms.
3. By shifting the region of spectrum under observation towards the violet. The resolving power varies inversely as the cube or slightly higher power of the wave length. This will be seen directly when we compute resolving powers, but it follows at once by differentiating Cauchy's form of dispersion formula.

$$\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \dots \text{ or simply}$$

$$\mu = A + \frac{B}{\lambda^2}$$

$$\frac{d\mu}{d\lambda} = -\frac{2B}{\lambda^3}$$

'The use of the second method increases the dispersion which is usually not allowable on account of the proportional increase of exposure time entailed. The third method can not be used with a refractor and glass prisms on account of the strong absorption of ultra violet light by the glass of the lenses and prisms. With a reflector and a quartz or ultra-violet glass spectrograph it might be applicable. We are therefore practically limited to the use of a larger prism and consequently larger collimator and camera lenses.

The size of prisms in use in radial velocity work, as previously stated, lies between about 30 and 51mm. Prisms of 51mm. aperture are successfully used in the Yerkes Spectrograph, but Frost's experience as also that of Hale in large spectro-heliograph prisms shows that the limit is nearly reached.

In discussing the necessary conditions for using a wider slit, let us take as an example a comparison between the efficiencies of single-prism spectrographs of 35mm., the aperture of the present instrument, and 51mm. aperture, the latter having been decided upon, after careful consideration, as the aperture of the new instrument. A spectrograph of such aperture, outside of considerations of the homogeneity of larger prisms, is the practical limit as regards size and weight that can be attached to a 15-inch equatorial.

The glass generally used for the prisms is Jena glass 0-102, Dense Silicate Flint, and this was chosen for the spectrographs here. It is very colourless considering its density and dispersion. The indices of refraction of the particular melting from which the present prisms were made, as furnished by the makers, are as follows:—

| Wave Length. | Index of Refraction. |
|--------------|----------------------|
| 00006563 cm  | 1.6413               |
| 00005893 cm  | 1.6467               |
| 00004862 cm  | 1.6603               |

From these values substituted in the Hartmann formula  $\mu = \mu_0 + \frac{c}{\lambda - \lambda_0}$  we obtain the values of the three constants  $\mu_0$ ,  $c$  and  $\lambda_0$ .

$$\lambda_0 = .00002190.$$

$$\mu_0 = 1.61146.$$

$$\log c = 6.115595.$$

From these constants were calculated for a number of wave lengths  $\mu$  and  $\frac{d\mu}{d\lambda}$ . From  $\frac{d\mu}{d\lambda}$ ,  $R$  was obtained for prisms of 35 and 51mm. aperture, and of refracting angle  $63^\circ 50'$ , this being the angle required to deviate the ray at minimum,  $\lambda$  4415,  $60^\circ$ . The formulæ used were previously derived and are:

$$\frac{d\mu}{d\lambda} = \frac{c}{(\lambda - \lambda_0)^2}$$

$$R = t \frac{d\mu}{d\lambda} \text{ where } t = 2a \sec \frac{A + \theta}{2} \sin \frac{A}{2}$$

| Wave Length. | $\mu$  | $\frac{d\mu}{d\lambda}$ | $R$<br>Prism 35 mm. | $R$<br>Prism 51 mm. |
|--------------|--------|-------------------------|---------------------|---------------------|
| 4862         | 1.6603 | 1829                    | 14420               | 21010               |
| 4550         | 1.6667 | 2343                    | 18470               | 26910               |
| 4415         | 1.6701 | 2636                    | 20780               | 30280               |
| 4341         | 1.6721 | 2822                    | 22250               | 32420               |
| 4102         | 1.6796 | 3490                    | 27520               | 40100               |
| 4000         | 1.6833 | 3983                    | 31400               | 45750               |
| 3970         | 1.6848 | 4119                    | 32380               | 47180               |

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'The resolving power for the two apertures obtained, the purity of spectrum for different slit widths is readily calculated from  $P = \frac{\lambda}{d \psi + \lambda} \cdot R$ ,  $\psi$  in this case, being  $\frac{1}{43}$  or .0667. The results are given in the following table for the wave length 4341 or  $H\gamma$ , this being the usual central ray.

PURITY OF SPECTRUM.

| Slit Width. | Prism 35 mm. | Prism 51 mm. |
|-------------|--------------|--------------|
| 0.025       | 4396         | 6697         |
| 0.040       | 3114         | 4537         |
| 0.051       | 2518         | 3670         |
| 0.063       | 2084         | 3036         |
| 0.076       | 1755         | 2558         |

'These figures show that with the larger prism the slit may be made 50 per cent wider and still have practically the same purity of spectrum, and consequently the same accuracy of velocity determinations.

'The slit transmission table previously given showed that an increase in slit width of 50 per cent when below 0.076mm. increased the quantity of star light transmitted by nearly 50 per cent; consequently, other conditions being equal, half as many more spectra could be made in a given time. But an increase in the size of the prism means also an increase in the quantity of light absorbed by the glass of the prism, although the amount reflected will be the same. We can obtain an accurate knowledge of the quantity of light absorbed in the two prisms of O. 102 glass from Vogel's experiments (Astrophysical Journal, V., p. 75), who showed that  $H\gamma$  light transmitted through 100mm. of O. 102 glass suffered absorption of about 47 per cent. The absorption for prisms of 35 and 51mm. aperture, average length of path 39 and 57mm. respectively,

may be readily calculated by the formula  $I_1 = I_0 K^{\frac{x}{a}}$ , where  $x$  is thickness of glass for which absorption is required,  $a$  is thickness for which percentage transmitted is  $K$ ,  $I_0$  intensity of incident,  $I_1$  of transmitted beam. We obtain for prism of 35mm. aperture 78 per cent, of 51mm. aperture 71 per cent transmission. If 100 be intensity of incident pencil for small prism, then 150 will be intensity of pencil giving equal purity with large prism. After transmission intensities will be 78 and  $150 \times .71$  or 106.5, respectively, and the required exposures will be inversely proportional or as 3 to 4, a very considerable gain. Even when the slight additional absorption in the thicker camera and collimator lenses is considered a substantial saving of time will result by the use of the larger prism.

'We have tacitly assumed in the foregoing discussion that a decrease of purity entails loss of accuracy in the velocity values. This is undoubtedly true for complex spectra such as those given by solar or allied type stars, spectra in which are hundreds of lines and in which every decrease in purity means increased uncertainty in the wave lengths of the more complex blends of lines thereby produced. In the case of early-type stars, however, such as those of the hydrogen or helium groups, where there are only few lines, and these single, there can be no trouble with blends, and the question of the purity of the spectrum has not so much weight. On such grounds there would be no material advantage in using the larger aperture. However, a consideration of the second effect produced by widening the slit—the increased diffuseness of the spectral lines—will show a similar advantage for the larger aperture even where purity does not come into question.

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' This may be best shown, as before, by considering a special case and we may take the same example with advantage. The present single-prism spectrograph has a collimator objective of 35mm. aperture and 35 x 15 or 525mm. focus. The camera has a focus of 525mm., and therefore the image of the slit on the plate will be of the same size, and the minimum width of line will be the width of the slit. The new spectrograph will have a collimator of 51mm. aperture and 51 x 15 or 765mm. focus. The camera will be of about 455mm. focus. Hence the image of the slit on the plate will be diminished in the proportion of 455 to 765 or about  $\frac{3}{4}$ . If the camera were of the same focus as the one now in use, 525mm., the image of the slit would be diminished to about  $\frac{3}{4}$ . Hence the slit can be made in the one case  $\frac{3}{4}$ , in the other  $\frac{1}{4}$ , the width with the present spectrograph, and have the lines of the same width, and consequently equally accurately measurable. The gain in efficiency is thus about equal under the latter consideration and that of the maintenance of equal purity, and we may therefore consider that a decided advantage may be obtained in stars of all types by increasing the aperture of the prism. Such conclusions are, of course, subject always to the test of actual use under similar external conditions before they can be accepted as final.

' However, some experiments that I made here last winter on the effect of widening the slit upon the accuracy of velocity determinations\* substantiate the above conclusion, and I will therefore give a short summary of some of the results reached. As previously stated, when the slit is widened, the purity is diminished and the lines become broader and more diffuse. To simplify the investigation, the question of the effect of purity was eliminated by choosing a star,  $\beta$  Orionis, for the test whose lines are single and moderately sharp. There remains, then, only the question of the effect of the increasing breadth and diffuseness of the lines on the accuracy of the measures. Evidently such a question can only be settled by making and measuring a number of spectra at each slit width. Six plates were made for each slit width 0.025, 0.038, 0.051, 0.076mm. for two dispersions, (a) single-prism 525mm. camera, (b) three-prism 525mm. camera and six each at slit widths 0.025, 0.051 and 0.076mm. for a dispersion of three prisms and camera of 275mm. focus. In all 66 plates were made, of which I have to thank Mr. Harper for measuring 18 and thus lightening the considerable labour involved. Owing to the different dispersions, different lines were measured in the three sets, but as the main dependence can be placed on the three lines  $Mg \lambda 4481.400$ ,  $He \lambda 4471.676$ ,  $H\gamma 4340.634$ , the results from these three lines only are given. Computations using all the star lines measured were also performed without, however, changing the conclusions reached.

' There are evidently two kinds of error to be considered, accidental and systematic. Under the first will be considered the accidental errors of the setting of the microscope wire on the individual lines in a plate, resulting in a mean velocity for that plate differing from the true velocity in a greater or less degree depending upon the quality of the lines. The systematic error of a plate is the displacement of the star lines as a whole with respect to the comparison lines. This may be due, as previously stated, to one or more of several causes—change of temperature, flexure, faulty adjustment or aberrations in the optical train, &c. As the lines are in general equally affected, such displacement will not be apparent in the measure of a single plate. It is only by comparing the velocities of a number of plates of a star of constant velocity that such an error can be detected.

' To compare the accidental errors for the different slit widths it will be necessary, to prevent systematic displacements from affecting the result, to treat the measures for each of the six plates for one slit width separately, to obtain the residuals from the mean velocity of each plate and finally the probable error of measurement of an average star line from these residuals. Some idea of the relative magnitude of the sys-

\* Since published in the *Astrophysical Journal*, Vol. XXVIII, p. 259.

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tematic errors may be obtained by treating the velocities from each of the six plates. However, this result will not be that due to systematic error only, as the velocity from each plate will also be affected by accidental errors. The results of the measures and computations are given below:—

## PROBABLE ERRORS.

| Dispersion.              | Slit Width. | Accidental Prob.<br>Error, Average<br>Line. | Systematic Prob.<br>Error, Single Plate. |
|--------------------------|-------------|---|--|
| Single Prism . . . . .   | 0.025       | ±4.5 km.                                    | ±1.7 km.                                 |
|                          | .038        | 2.4   | 2.7                                      |
|                          | .051        | 2.3   | 3.0                                      |
| 525 mm. Camera . . . . . | .076        | 4.3   | 7.7                                      |
|                          | 0.025       | ±2.3  | ±1.5                                     |
| Three Prisms . . . . .   | .038        | 2.1   | 1.3                                      |
|                          | .051        | 2.5   | 0.7                                      |
| 525 mm. Camera . . . . . | .076        | 2.1   | 0.9                                      |
|                          | 0.025       | ±2.9  | ±2.1                                     |
| Three Prisms . . . . .   | .051        | 2.9   | 3.0                                      |
|                          | .076        | 3.8   | 2.9                                      |
| 275 mm. Camera . . . . . |             |   |  |

These results were to a considerable extent unexpected. The great difference in the apparent quality for measurement of the spectra made with slit 0.025 and 0.076mm., especially with the single-prism, would lead one to expect a marked increase in the errors of setting, but this is not very distinctly shown, not at all in the higher dispersion. The systematic errors, however, are very markedly increased in single-prism plates, so much so as to prohibit the use of slits wider than 0.051mm. In a higher dispersion spectroscopy this increase has disappeared, and, so far as the rather small number of plates shows, it is slightly more accurate in the case of dispersion (*b*) to use slits 0.051 and 0.076mm. than slits 0.025 and 0.038mm. It is evident that these results corroborate the conclusions previously reached, by showing that increase in resolving power removes or diminishes the loss of accuracy when the slit is widened. Consequently, with the 50 per cent greater resolving power and the 60 per cent greater ratio of collimator to camera focus, it is probable that the slit-width may be increased 50 per cent without affecting the accuracy of the results and with a corresponding increase in the output.

*Mechanical Design.*

The question of the most favourable dimensions of the optical parts having been discussed, there remains the mechanical structure connecting these parts into one stable whole. Owing to the attachment of the instrument to a moving telescope and the consequent varying direction of gravity on the parts, the prevention of flexure is one of the most difficult of the problems to be overcome, and this is especially the case where the instrument is to be attached to a telescope of moderate size, where its weight can not exceed a certain small limit. The weight of our spectrograph complete with temperature case, attaching truss, &c., can not much exceed 100 lbs., and the problem is consequently a much more difficult one than in the case of the Yerkes equipment, for example, where the spectrograph weighs about 500 lbs. Most of the early and some of the recent spectrographs have lacked sufficient stiffness and stability to prevent line displacements due to flexure of the parts. A displacement of the camera and plate of only one one-thousandth of an inch is equivalent in a single-prism spectrograph to a velocity of about 50km. per second. It is evidently a difficult

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matter in the extended form of a single-prism instrument to reduce this flexure to an inappreciable amount. No material is perfectly rigid and when we consider that even its own weight deforms the strongest material available, the difficulty of the problem will be realized.

'Until very recently all spectrographs were attached to and overhung the end plate of the telescope and thus, like a beam fixed at one end, were subjected to the maximum amount of flexure. An improvement in the principle of attachment was applied at the Lick Observatory recently, in which the spectrograph proper is made self-contained and is held in an independent cradle at two points of support. It is thus like a beam supported at both ends and the flexure is thereby much reduced.

'The original spectroscope belonging to the Observatory was by Brashear of an adjustable universal type and was not, for this very reason, suitable for radial velocity determinations. Braces were added to stiffen the frame as much as possible, but it could not be freed from flexure. Many of the results obtained were uncertain and its use was discontinued as soon as a new combined one and three-prism spectrograph, designed by myself and very satisfactorily constructed by Mr. Mackey in the Observatory workshop, was completed.

'This instrument, whose general form is readily obtained from the figures, page 78 in my report to the Chief Astronomer for 1906-7, has many original features, has given excellent satisfaction and produced reliable results. It is, as will be noticed, a form of the first class mentioned attached only to the end plate of the telescope. It was designed and partly constructed before anything was learned of the new type. Moreover it was desired for the sake of economy of time and money to combine single and three-prism instruments in one (since found by experience to be a mistake), and this could not be advantageously effected in the new form.

'The form of truss designed has some advantages over previous instruments, and has probably less flexure than any other of the same type and weight. The main difference lies in the close grouping of the triangular truss at the lower end and the addition of the substantial diagonal brace, which serves the two purposes of stiffening the outer end of the prism box and lower end of the camera when used in three-prism work, and of tying the outer end of the camera when used with a single prism. The maximum flexure of the three-prism instrument is equivalent to 1.8km. only, while the maximum flexure of the modern Bonn three-prism instrument, the only one for which data have been published, is about 70km. For an hour's exposure with the Bonn instrument there is a flexure of 7km., while a similar exposure with both single and three-prism forms here shows no appreciable flexure. The maximum flexure with our single prism is much greater, about 100km., equivalent to a linear displacement of about  $\frac{1}{400}$  inch. This great difference in the two forms is due to two causes. First, to the threefold greater kilometre value for the same linear displacement. Second, to the much more extended form of the single-prism instrument. Calculations have shown that the amount of flexure is nearly that caused by the actual extension and compression of the truss members due to their own weight, and consequently it can not be avoided or much reduced in this form of instrument. However, the flexure occurring during a two hour's exposure is only slight except at such great hour angles as are rarely used.

'Both forms of instrument are frequently required on the same night, for stars of varying brightness and type. The time lost in making the change from single to three prism or vice versa, and the uncertainty in the temperature conditions prevailing after the change, close temperature regulation being equally as important, perhaps more important than avoidance of moderate flexure, were considerations leading to the decision, which had the approval of Dr. King, to design and construct a separate single-prism spectrograph, with separate temperature control and attaching stand, so that the change could be made in a minute or two, and without disturbance of temperature.

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' Besides using a larger prism for the reasons fully entered into above, the opportunity was taken of changing the mode of attachment to the telescope. Curtiss, of Ann Arbor, designed a form of single-prism instrument modelled after the Lick pattern, which has two points of support, one near the slit and the other near the base of the prism. The spectrograph proper consists of a triangular brass box with angles of about  $120^\circ$ ,  $30^\circ$ ,  $30^\circ$ . The prism is at the obtuse and the slit and camera at the acute angles of the triangle. The camera end hangs out unsupported and flexure will still occur though in a much diminished degree.

' The form I have designed and am now having constructed in the workshop follows that of Curtiss in that it is of the box form, but the design and construction of the box and the method of attachment to the telescope are different. The box is made of hard cast-steel plates (saw steel) much stiffer than brass, is rigidly braced and cross braced, and is provided with three points of support in a cradle of T iron attached to the end plate of the telescope. Two of the points are similarly situated to those of Curtiss, while the third acts near the camera end. The two first are attached by a kind of universal joint, so that no strain can be induced in the box by any bending of the cradle. The third support, near the camera, consists of a pair of counter-balancing levers, one on each side of the box, arranged to equalize the pressure on the three supports in any position of the telescope without it being possible to ever induce any strain in the box itself. By this means it is believed that no measurable or even noticeable flexure will occur.

' A simple triangular box of this form without projections of any kind is much more readily adapted for temperature regulation than the complicated shape of the regular truss form. Moreover, any stratification in the temperature case is much less likely to occur, and if it does, can not do nearly so much harm as if it were acting on only one member of the truss. A further improvement will be the introduction of a non-conducting material, such as vulcanized fibre in the supporting arms between the cradle and the box, so that heat will not be conducted away at these points and unequal temperature and possible distortions take place.

' In the present spectrograph, conduction through the arms of the truss is so great as to cause a gradual drop of the temperature in the prism box, as the outside temperature falls, of about  $0.1^\circ\text{C}$ . every one or two hours. The distance between the spectrograph box, which will be entirely covered with thick felt, and the inside of the felt-lined outer case will be uniform, the heating wires will be uniformly distributed, and consequently little difficulty with inequalities of temperature should result.

' Although until the instrument is completed and tested, no definite statement can be made, I have little doubt that the new spectrograph will be a considerable improvement over the present or any existing single-prism instrument.'

## THE NEW SINGLE-PRISM SPECTROGRAPH.

*The Optical Parts.*—After the dimensions of the optical parts of the new instrument had been determined as above they were ordered from the J. A. Brashear Co., in the early part of 1908.

Some correspondence was carried on in regard to the 'Isokumatie' Collimator objective in reference to the yellowish colour of the middle component. It was, however, decided to use it in preference to the less absorbing ordinary objective, on account of the flatter colour curve given by the former. Consequently an 'Isokumatie' of 51mm. (2 inches) free aperture and 765mm. focus was ordered and received at the same time as the other optical parts, about the end of last March. Although no direct tests have as yet been made, there is no question of its being a first class objective, as otherwise the good definition now obtained would not be possible. The prism of Jena glass O. 102 had its angle  $63^\circ 30'$  computed, so that the central ray for this instrument  $\lambda 4325$  had a deviation of  $60^\circ$ . The length of the side of the prism was made 110mm.,

so as to transmit the full pencil from the collimator, and the height 57mm. in order that any effect produced by pressure or unequal temperature of the supports might be minimized. The prism is a beautiful piece of glass and the tests have shown it to be of first rate optical quality, and fears as to its possible lack of homogeneity groundless.

The camera objective, owing to the excellent performance of the Brashear Single Material in the previous instrument, was chosen of the same type and is of 57mm. aperture, a sufficient margin above 51mm. to transmit the full usable pencil, and 455mm. focus. It was tested soon after being received and, although it gave a flat field, the definition was not as good as that given by the original objective, and a preliminary test showed this to be due to spherical aberration. The objective consists of two widely separated converging elements of very light crown glass, and consequently the resulting positive aberration can only be removed by departure from spherical surfaces. The amount to be removed in the case of the original objective of 45mm. aperture and 525mm. focus was quite within the possibilities of ordinary figuring, but when the aperture ratio is increased to so large an extent as from  $f12$  to  $f8$ , it becomes a much more difficult problem to deal with. In this case it was only after the introduction of a special method and with the great personal skill of Mr. McDowell in figuring, that the aberration was finally removed, and the objective gave practically perfect definition and a widely extended flat field. A full description of the tests, with the plotted fields resulting from different objectives, is given in full in another place.

*The Guiding Telescope.*—Instead of reflecting the light used for guiding down a tube parallel with the collimator and there further reflecting it to the guiding telescope so placed as to also receive light reflected from the front surface of the prism, the guiding telescope has in this case been placed about 15cm. above the slit, where star light coming from the inclined speculum-metal jaws is reflected by a right-angled prism to a small objective placed at its focal distance along the optical path from the slit. The resultant parallel pencil is then received by the bent guiding telescope shown, Fig. 2, which can be rotated to any convenient direction. Two reflections are hereby avoided, resulting in some saving of light and probably better definition. It had been found in the previous instrument that the method of guiding by light reflected from the front prism surface was never used, and consequently in the new spectrograph this needless complication was omitted. It may be said, however, that the position of the guiding telescope is in some positions of the equatorial, not quite so convenient as if it were lower down.

*The Comparison Apparatus.*—Experience has shown that in actual work more than one metal is never used as electrode, and consequently the rotating wheel with four sets of electrodes used previously has been omitted here, and one pair of adjustable electrodes of the alloy of iron and vanadium, whose spectrum is exclusively used for comparison, has been substituted. These terminals are mounted on a brass plate which swivels on two points attached to the top of the guiding telescope, and when not in use is simply turned back upon the latter, thus leaving the star light unobstructed. Directly below the terminals in the optical axis is screwed the short tube shown, in the upper end of which is a piece of ground glass and in the lower a small condensing lens with an angular aperture twice that of the collimator. Both of these are adjustable and ensure in every case a uniform pencil of spark light incident upon the collimator objective and prism.

*Slit and Slit Diaphragms.*—The slit is of the Huggins type of reflecting slit, with polished speculum metal jaws inclined at an angle of  $3\frac{1}{2}^\circ$ , so that the reflected pencil of star light and consequently the prism which intercepts it is entirely out of the way of the direct pencil. One jaw is fixed and the other movable micrometrically, a single division representing .001 inch (.025mm.). The slit has a tangent screw slow motion to enable it to be placed exactly parallel to the refracting edge of the prism, and is very



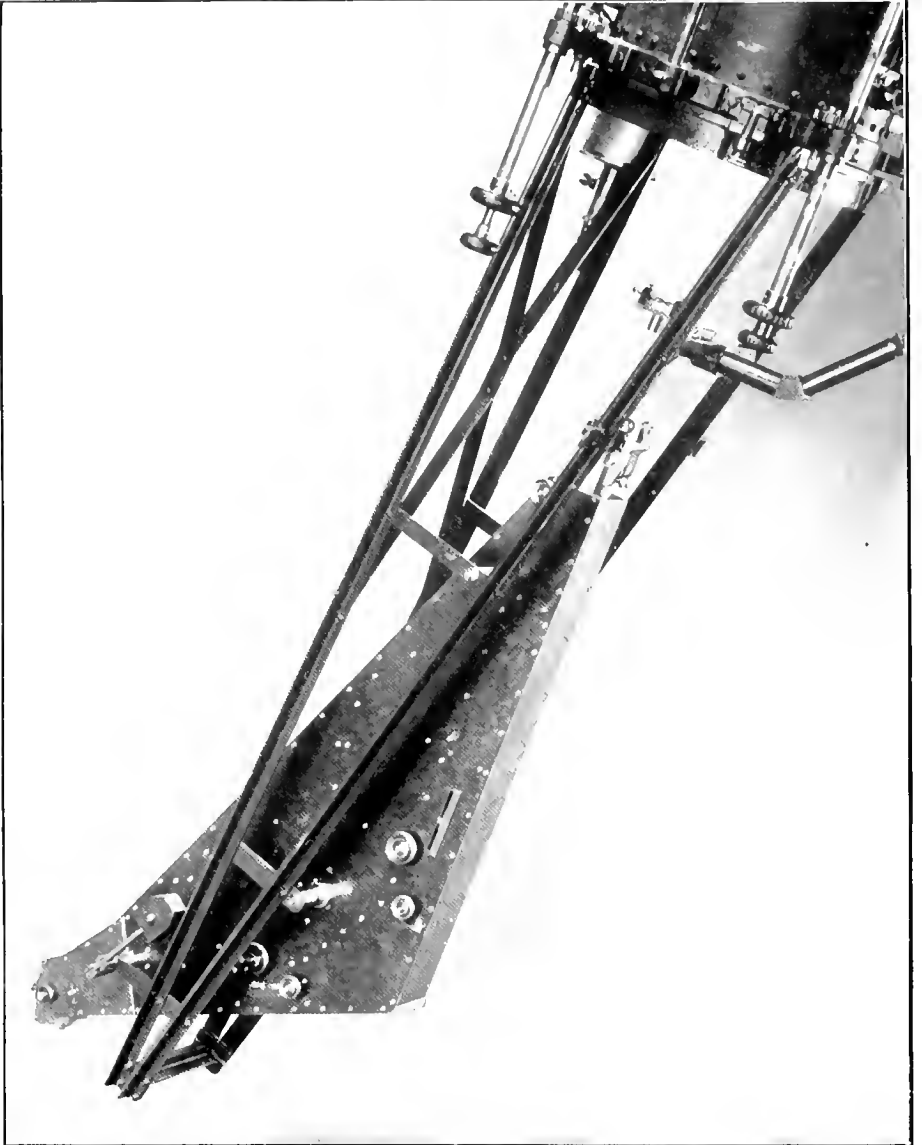
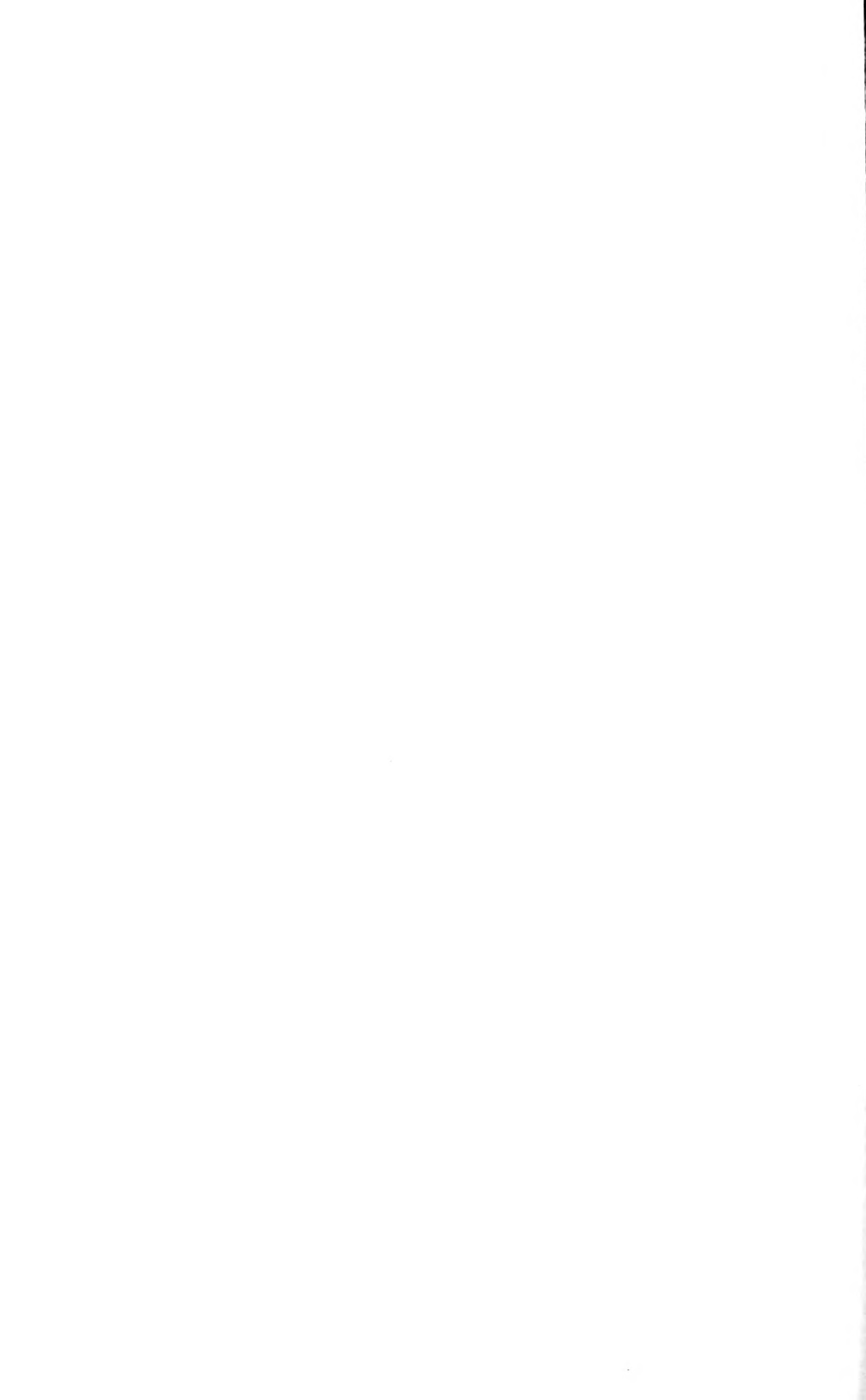


FIG. 2 --New Single-Prism Spectrograph.



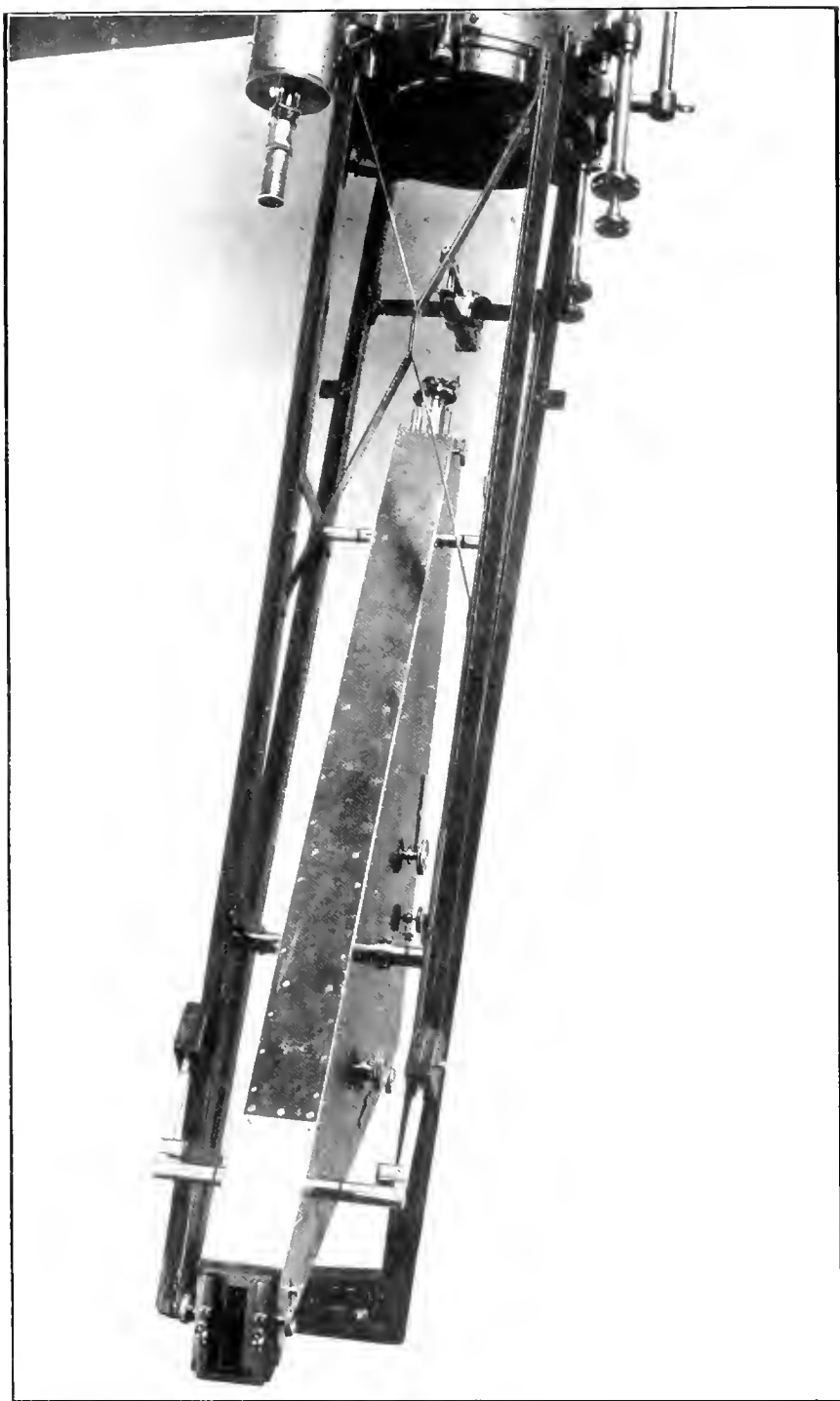


FIG. 3—New Single-Prism Spectrograph.



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rigidly attached to the end of the heavy collimator tube. To the end of this tube is also screwed the attachment holding the sliding diaphragms, which serve to limit the star and comparison spectra. Rectangular openings of the proper width, in this case a single opening 0.4mm. for star spectrum and two openings 1.5mm. separated by a tongue 0.45mm. for comparison spectrum, are placed directly opposite one another on a plate which is moved by means of a knurled wheel transversely between stops across the slit. To expose the spark spectrum all that is necessary is to turn down the spark apparatus, turn the knurled wheel above mentioned about a quarter turn, and close the switch which controls the current through the step-up transformer used for producing the spark, this switch being on the telescope tube about a foot above the spark apparatus. To change back to star spectrum the operations are reversed, the whole cycle occupying only about ten seconds.

*The Mechanical parts.*—As outlined above the instrument consists essentially of two parts—1. A rigid, hollow, triangular shaped, steel box containing at the obtuse angle the prism, and at the two acute angles the slit and plate and comprising the spectrograph proper; 2. The T iron frame or cradle attached to the end plate of the telescope, in which the spectrograph proper is flexibly supported, and which serves to keep it collimated without flexure of this support producing any stresses in the box itself.

*The Spectrograph Box.*—The box consists of two triangular shaped plates made of hard saw steel about 1.7mm. thick forming the sides, while the edges consist of plates of the same material and thickness, 79.4mm. ( $3\frac{1}{4}$  inches) wide. In addition to the edges there are a number of internal braces and supports of the same material, well shown in Fig. 4, which gives a good idea of the construction of the box. These braces as well as the edges of the box have pieces of small angle iron securely riveted along both edges, to which the side plates are firmly screwed. These angle irons are not shown in the figure, as the frame was first put together, the angles then riveted on and finally the plates screwed to these angles and to the internal castings, the heads of the screws being shown on the side of the box in Fig. 2. It was constructed in this manner to prevent as far as possible any internal stresses in the frame of the box. In addition there are iron castings *A, B, C, D, E, F*, Fig. 4, planed to exactly the same width as the edges and braces. *A*, may be called the main casting, having a hole bored through the centre through which the principal supporting shaft passes. The two legs projecting from the triangular part are bored out to fit the collimator and camera tubes. The casting, *D*, is also bored out for the collimator tube and forms the end plate of the box, while the casting, *F*, is bored out to carry the upper end of the camera tube. *C*, and *E*, have clearance around them and do not touch the collimator tube, the upper support being attached to the centre of *C*. The part, *B*, has the third supporting shaft screwed into the centre of each side, and also forms the connection between the box proper and the camera end. The latter is made separate, so that camera objectives of different focal lengths may be used if desired.

The prism is mounted in a separate cast-iron cell, but is prevented from touching the metal at any point by facings of hard rubber about 3mm. thick, and is kept in its adjusted position by hard rubber stops. It is held firmly in this position in the cell by the gentle pressure produced by three small clamp screws passing through the top of the cell and bearing upon one of the facings of hard rubber 3mm. thick, above mentioned, resting on top of the prism. The base of the cell is surfaced flat, and rests in its compartment on one of the side plates, to which it is rigidly attached by five screws passing through slotted holes to permit of adjustment for minimum deviation.

Collimator and camera tubes are provided with racks and pinions for adjustment, their position being read on millimetre scales, the one attached to the camera being provided with a vernier, reading to tenths of a millimetre. The collimator tube is provided with two clamp screws, one at the top and one at the bottom bearing, while

the camera tube has a single clamp screw at the front end. The pinion and clamp wheels and the scales are well shown in Figs. 2 and 3. The camera attachment, whose form and construction can be fairly well obtained from Figs. 2 and 3, is built in box form of the same material, and is firmly screwed to the casting, *B*, Fig. 4, it and the spectrograph box thus forming what is to all intents and purposes one continuous piece. Between the sides of the camera box, swivels the plate holder attachment which is quite similar in form to the one used with the other spectrograph. It consists essentially of a semi-cylinder 79.4mm. long, 101.6mm. diameter, pivoted along its axis between the sides of the box to permit a wide range in plate inclination. This cylinder is constructed from a section cut from a piece of 4-inch brass tubing, on the ends of which pieces of heavy brass plate are screwed and soldered, and on the plane of section is fastened the brass camera back provided with screws for clamping the holders firmly in place. The plate holder carrier has solidly constructed ways permitting lateral movement of about 15mm., enabling a number of narrow spectra to be made side by side on the same plate if desired. The axis on which the camera back rotates is provided with knurled clamping wheels, while other screws moving in concentric slots enable adjustment and firm clamping to be effected in any desired position, read off on graduations on the cylinder.

As will readily be seen from its design and construction and from the character of the material from which it is made, this spectrograph is exceedingly rigid and the flexure produced by changes of position, however supported, would be very small. This flexure, however, is reduced to a vanishingly small quantity by the new supporting system used in this instrument. The self-contained spectrograph box is, as has been indicated above, supported flexibly on three points in the carrying cradle.

*The Supporting Cradle.*—This truss made of 1½" T steel is attached at the upper end to a heavy ring casting, which is fastened by the same three swivel bolts used for the other spectrograph to the end plate of the telescope, the mode of attachment being shown in Fig. 3, which with Fig. 4, well shows the form of the truss. It is evident that the only flexure of this truss in a direction parallel to the sides of the spectrograph will be that due to the extension of one arm and compression of the other in each pair, and this will hence be very slight. Owing to the fact that these two pairs of trusses had to be separated about 20cm. at the lower end, to admit the spectrograph with outside temperature case between them, it is evident that flexure in a direction at right angles, parallel to the movement in right ascension, will be greater. This is minimized as much as possible by joining the two ends by a solid webbed casting and by introducing cross braces at the upper end of the truss as shown. At small hour angles, however, which it is desirable for many reasons to use as far as possible, the component of the weight in this direction will be very small and the flexure negligible. Even at large hour angles which are sometimes required, the flexure cannot be great. In any case from the method of attaching cradle and box, to be presently described, no flexure of the cradle can induce any stresses in the box and the only effect of such flexure will be to slightly alter the axis of collimation of the spectrograph. This can not, however, induce any displacement of the spectral lines, not only on account of its relatively small magnitude but also because it can occur practically only parallel to the spectrum lines and to the refracting edge of the prism, which will have no effect on the position of the line.

The principal and central support and connection between cradle and box consists of a shaft 1 inch (25.4mm.) diameter passing through the hole in the main casting. This shaft is left the full size of the hole only for about 2mm. at the centre, so that the box is free to swivel in every direction around the centre to the extent of 2 or 3 degrees. This swivelling motion is, however, limited, by projecting points on the shaft at the ends of the hole, to one parallel to the motion in right ascension and to the slit, rotation around the axis of collimation being prevented. Consequently any flexure of the cradle can not induce any distorting stress in the box.

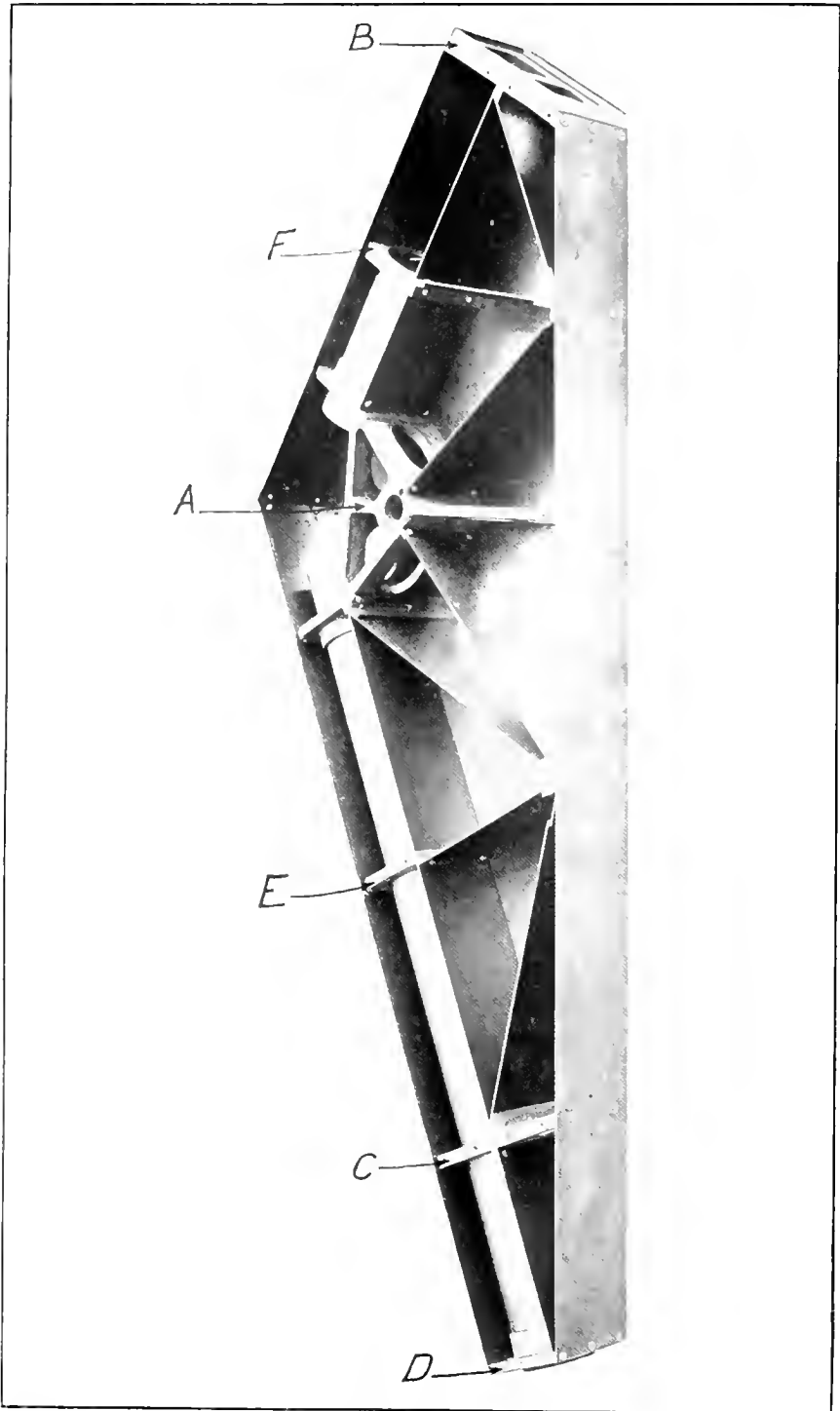


FIG. 4—Spectrograph Box.





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The upper supporting shaft has a transverse hole in the centre through which a pin screwed into casting *C* passes, thus allowing longitudinal motion parallel to the axis of collimation as well as swivelling motion in every direction.

The third point of support consists of shafts rigidly screwed into the centre of each side of casting, *B*. A second short shaft at each side carried by plates screwed to the cradle, as shown (Figs. 2 and 3), is placed about 2.5cm. from the first in a direction which, if produced would nearly pass through the centre of mass of the box. A lever attached to these two shafts at each side in such a way as to allow more than sufficient motion without binding, carries a counterbalancing weight, the combined resultant upward thrust of the two on the box being computed to equal the proportional part of the weight that should be carried by this support.

The box is hence carried equally on the three supports without any possibility of distortional stresses occurring in it due to flexure of the cradle, the only effect of such flexure being to slightly change the axis of collimation, which at the utmost can only induce displacements of the second order in the position of the spectral lines.

*Temperature Control.*—Every precaution having been taken, successfully as will be seen later on, against flexure, there remains, as the other main cause of systematic displacements possibly more dangerous than flexure, displacement due to changes of temperature in the optical and mechanical parts of the instrument. The changes in temperature between day and night or even between evening and morning at Ottawa are considerable, averaging about 8°C. for the former and 6° for the latter. In many cases the temperature in the dome becomes 10°C. lower than that in the temperature case, rendering satisfactory maintenance of constant temperature in the case a difficult matter.

As mentioned in the two previous reports, such difficulty was experienced and the temperature in the prism box dropped gradually about 0.1°C. per hour as the temperature in the dome became lower. When practically the whole of the inside of the case was covered with the heating coils this drop was not so great, but was not entirely overcome. It was believed to be due to the conduction of the heat through the metal parts of the attaching truss, the collimator tube, &c., exposed to the outside air and that, although the temperature inside the case undoubtedly remained nearly constant, the temperature inside the prism box would diminish with the lowering of the outside temperature owing to the greater loss of heat through the exposed supports.

To overcome this as far as possible in the new instrument all of the shafts attaching the box to the cradle were cut at points about 3cm. from the box, just inside the outer case, were bored out and threaded, and a piece of vulcanized fibre separating the ends about 7mm. screwed in. This fibre, seen dark on the shafts in Fig. 3, is a poor conductor of heat, prevents direct metallic conduction from the box inside the temperature case to the cradle outside, and the only part of the spectrograph exposed is the slit head. The temperature inside the outer case is automatically controlled by a pair of electric contact thermometers placed not, as in the previous instrument, one on each side of the prism box, but one in the front near the upper end and one at the back near the camera.

Each of these thermometers controls the heating coils in the corresponding half of the outer case. It was hoped by thus arranging the thermometers and coils to keep the temperature over the whole interior of the case more nearly uniform than previously. These thermometers act in exactly the same way as in the former instrument described in the 1907 report. When the temperature in the case rises the mercury in the open capillary makes contact with an adjustable platinum wire and the resulting battery current attracts the armature of a relay, thus breaking the heating circuit; similarly when the temperature falls the mercury recedes from the platinum terminal, the relay armature is released and current is turned on the heating coils. In practice the regulation is very good, current in the coils as indicated by pilot lamps being turned on and off every few seconds. To smooth down any remaining irregu-

larities the whole exterior of the spectrograph box is covered with a layer of half-inch thick felt, small hinged doors being made over the indexes and scales of collimator and camera.

The temperature case is in this instrument constructed of wood chiefly on account of its greater ease of construction, of its greater heat insulating power, and of the smaller danger of short circuits in the heating coils over one made of aluminum. Moreover, owing to the simple form of the spectrograph, a wooden case can easily be made amply strong. This case is made of  $\frac{1}{4}$ -inch thick pine, lined inside with felt about  $\frac{3}{8}$ -inch thick and is divided into three sections, the line of junction of the body of the case necessarily following the supporting shafts. The third section, which was necessary for constructional reasons, is a small box-shaped piece at the camera end. All joints between the sections and the joints around the doors in the case, necessary for the adjustment and clamping of collimator and camera and of the contact wires in the thermometers, are carefully padded with felt to be air-tight. This case, which is shown in Fig. 5, is attached securely to the supporting cradle and does not touch the spectrograph proper, the openings around the end of the collimator tube and the supporting shafts being made large enough for free clearance and at the same time heat-tight by washers of felt.

On the felt lining on the inside of this case is stretched about 1,200 feet No. 28 single silk covered German silver wire, arranged in four circuits of 300 feet each, two of these circuits in multiple are controlled by each of the electrical contact thermometers, each governing the coils in its own section of the case. This wire is distributed as uniformly as possible over the inside of the case, the space between the felt coverings of the case and spectrograph being about 2.5cm. and uniform throughout. By the division of the heating coils into two sections, their uniform distribution, and the uniform space between spectrograph and case, the temperature throughout the case should be maintained nearly uniform and not much trouble with unequal temperature should occur. There is no question that some method of mechanical stirring of the air inside the case would give better results, but the difficulty of additional weight and complication with possible vibration prohibit its use.

The temperature control so far as it has been tested works admirably. There is as before a slight drop in the temperature of the prism box when the external temperature drops rapidly, but that does not last long, and by applying the control in the afternoon, thoroughly ventilating the dome so that considerable of the cooling will have taken place, the temperature remains steady for the night.

*Adjustment of the instrument.*—After the instrument was completed there were several adjustments to be made before any measurable spectra could be obtained. The first of these was to set the slit at the principal focus of the collimator lens. This was done by Schuster's method of alternate focussing of collimator and observing telescope on the same spectral line, the prism being placed alternately to one side and the other of the position of minimum deviation. This method gives satisfactory results, successive values agreeing within two or three-tenths of a millimetre and the mean of several being taken. The prism was easily set to minimum deviation for the line *Fe*, 4325.9. This particular line was chosen on account of the very irregular results given by the line  $H_{\beta}$  in the numerous measures of  $\beta$  Orionis, and the consequent determination to shift the central line towards the violet in the new instrument. The measures above referred to show that more accordant results are obtained with the lines to the violet end of the spectrum than with  $H_{\beta}$ , and as resolving power, purity, and linear dispersion are all greater there, this should result in a further increase in accuracy. The camera focus is determined in precisely the same way, as with the previous instrument, by making adjacent spectra through the refracting edge and base half of the prisms, and determining the focus by the continuity of the lines. A slit is cut in the side of the spectrograph box into which a semicircular diaphragm can be

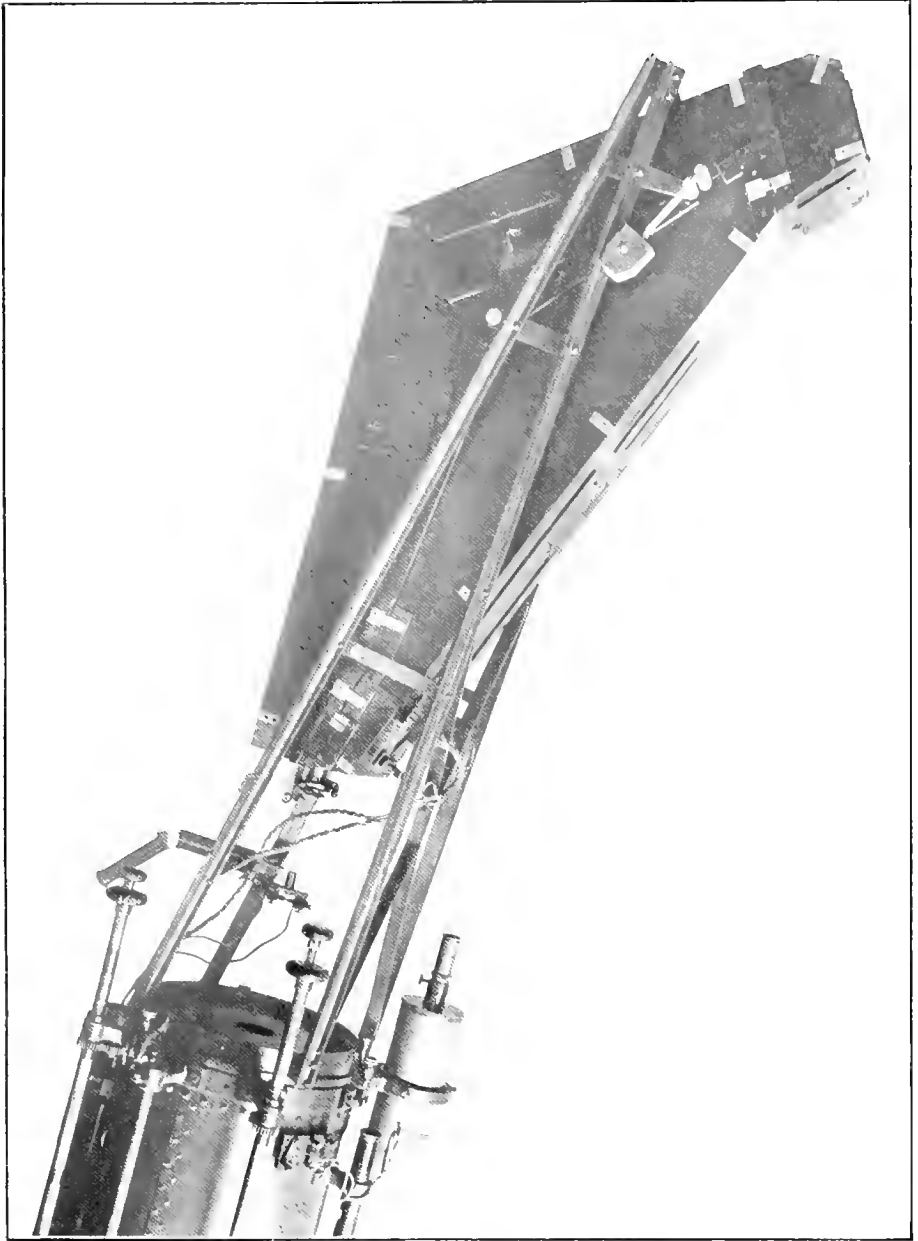


FIG. 5—New Single-Prism Spectrograph, ready for use.



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placed and rotated, so as to occult first one and then the other half of the light pencil. The inclination of the plate, determined of course at the same time, is about  $16^{\circ}.5$ , the same as with the first objective of this type.

A very curious and at the same time very useful property of the new spectrograph is the constancy of focus of the system for different temperatures. With the two previous instruments, the focal setting increased with increase of temperature about  $.012\text{mm.}$  per degree centigrade. Between the temperatures of  $0^{\circ}$  and  $20^{\circ}$ , all so far tested in the new spectrograph, the camera setting remains unchanged at  $27.69$  as determined by a number of careful tests. This with the absolute constancy and rigidity of the new instrument is a point of very great value in obtaining accurate results, as it obviates the necessity of testing the focus each time the instrument is used with the possibility of mistakes in the determination of the true setting. It is difficult to explain why there should be this difference, although it is probably due to the fact that the parts connecting camera objective and plate are of steel in the new instrument instead of brass, whose coefficient of expansion is greater. At any rate the combination of brass collimator tube, whose setting is unchanged, and steel camera tube gives settings for camera focus constant at all temperatures so far observed. If the collimator tube had been steel or the camera tube brass, there would have undoubtedly been a change in the setting with change of temperature.

*The New Spectrograph in practice.*—As stated above the instrument was only completed in the beginning of March, and consequently has not been in use long enough to enable its advantages and disadvantages to be fully determined. There is, however, no question that spectra of better quality for measurement will be obtained with it than with the single-prism form of the previous instrument in which the lines were occasionally, especially with the longer exposures somewhat blurred and diffuse, due to flexure or temperature change or both. As will be seen later, flexure in the new instrument is absent, and owing to its compact form any temperature changes should have much less effect on line displacements. As a matter of fact the temperature regulation is much better with the new instrument and no spectra yet obtained, even with very long exposure, show any trace whatever of diffuseness of the lines. Again, the constancy of the camera focus is another factor tending to better results, as one is always sure of the true focus and no fear of systematic displacements due to poor focus can arise.

Tests have been made similar to those of last year, on the relative freedom from accidental and systematic errors of spectra made at different slit-widths. These show, that on the whole in early type stars with this instrument more accurate values are obtained with a slit about  $0.051\text{mm.}$  wide than with slits narrower or wider. The comparative exposures required with the new instrument at slit-width  $0.051\text{mm.}$  and the previous single-prism instrument at slit-width  $0.038\text{mm.}$ , which gives about the maximum accuracy obtainable with it in early type stars, shows an advantage, so far as can be at present determined, of about 25 per cent for the new instrument. To offset this, however, it must be stated that, owing probably to the increased absorption of the larger prism, the intensity of the spectrum at the violet end is appreciably less and for equal intensity of the *K* line, sometimes required, most of the advantage will be lost. In the case of stars in which the extreme violet is not required, however, there is a considerable saving in time and increase in output by the use of the new instrument. This loss in the violet may be due possibly to other causes than absorption of the prism, such as in the guiding or the position of the corrector and form of the colour curve, and if such is the case, and this will be shortly tested, it may to a great extent be overcome.

Careful tests of the flexure of the new instrument have been carried out showing exceedingly satisfactory results. The method of testing was to attach the spectrograph to the telescope, the latter being pointed to the meridian. If the telescope is

turned in declination pointing first to the south and then to the north horizon, it is evident that the spectrograph will have rotated in its own plane through  $180^\circ$ , and there will have been induced in it the maximum possible double flexure. In these two positions spectra were made through a suitable slit diaphragm, the one used for focussing in which the adjacent spectra touch each other being the best, as any displacement of the line between the two exposures will at once be evident. Three sets of exposures of the comparison spark were made on the one plate, by sliding the camera back in its ways between exposures, two for flexure and one with the spectrograph stationary for comparison. Examination of these plates showed no measurable flexure. In some of the lines a very slight displacement could just be detected under high power magnification, but this if due to flexure was quite beyond measurement. As a matter of fact, on the plate being given to Mr. Harper with the request to select from the three the spectrum in which no movement had occurred, he found it impossible to determine which spectra were affected by flexure. As the flexure present during any reasonable exposure can only be a small fraction of that given by the method above described, it is quite evident that the spectra will be absolutely free from any line displacement due to flexure of the spectrograph. It may be of interest to state that flexure tests made of the instrument with the counterbalancing weights removed, and with consequently only two points of support, also showed remarkable freedom from flexure. Although the flexure was slightly more perceptible it was again quite immeasurable, showing the great stability and rigidity of the form of construction adopted.

The previous single-prism spectrograph showed when first constructed a flexure of about .035mm., equivalent to a velocity of 70km. per second. When tested at the same time as the new one it was found the flexure had increased to nearly .060mm., equivalent to over 100km. per second. As a displacement of the sharp comparison lines equivalent to a velocity of two or three kilometres would be measurable, it is at once seen how much more stable the new instrument is. It is, so far as I can learn, more stable than any other single-prism spectrograph in existence.

The new single-prism instrument, owing to its greater aperture and its design, is necessarily heavier than the three-prism spectrograph and some changes were necessary in the arrangement of the counterweights for balancing. As will be seen from Figs. 2 and 5, the centre of mass is considerably to the left of the optical axis, and in order to properly balance in declination, weight would have to be added to the opposite side of the tube near the object glass. Consequently rods for carrying weights were attached to both north and south sides of the tube near the objective, and the telescope can now be easily placed in good balance whatever attachment is used.

A counterweighted stand for attaching and detaching the new spectrograph, and for carrying it when not in use is provided. It is of quite similar construction to that used with the previous instrument, and allows the spectrograph to be fastened to the telescope in about a minute. With the separate relay box and set of plug contacts, both spectrographs may be maintained at constant temperature, and the change from one prism to three prisms or vice versa made in two or three minutes without disturbance of the temperature regulation in either case.

There will now be given the results of the tests of the new 'Single Material' and the 'Ross Special Homocentric' lenses, and, for completeness, the whole paper, as it will later be published in the *Astrophysical Journal*, will be given.

#### CAMERA OBJECTIVES FOR SPECTROGRAPHS.

It is well known that the camera objectives in general use in stellar spectrographic work have a very limited field of good definition, not exceeding in general  $2^\circ$ , which covers, in the usual dispersion of three prisms, about 200 tenth-metres. While this is a sufficient range for spectra of the second type, which are rich in lines, it is not sufficient for early-type spectra which may contain only one or two lines in this region, and in which, consequently, the errors of measurement will be high. As practically

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the whole photographic region of the spectrum,  $H_{\beta}$  to  $K$ , may be obtained in one exposure with either refractor or reflector, it is evident that a considerable gain in the measurable material in such spectra would be obtained, without increase in exposure time, if a camera lens giving a considerably wider field were available.

Various attempts at the solution of this problem have been made, of which the most successful known to me is that described by Hartmann.\* This objective made by Zeiss, known as the 'Chromat,' is constructed of the same material as the prisms, and is composed of two simple meniscus elements, one positive, one negative, separated by a small air space. As there is no chromatic correction the spectra are brought into focus by inclining the plate towards the violet about  $16^{\circ}$  from the normal to the axis with a dispersion of three prisms. According to Hartmann this objective gives a flat field of  $14^{\circ}$ . A Zeiss 'Chromat' has been in use in Ottawa for considerably over a year, entirely fulfilling expectations and giving, after slightly increasing the separation of the elements, the whole field used, from  $H_{\beta}$  to  $H_{\delta}$  (about  $8^{\circ}$ ), almost absolutely flat with excellent definition. There can be no doubt that the field would extend farther if necessary.

Unfortunately, as was learned upon inquiry from Zeiss, this type of objective cannot be successfully made of a larger angular aperture than about  $f12$ . This was confirmed by the performance of a shorter focus lens of the same type (aperture ratio  $f8$ ) constructed by Brashear which gave inferior definition. More recently, however, Ross Limited, London, have designed and constructed especially to conform to our requirements a lens similar in form to their 'Homocentric,' consisting of four separated elements, but following the principle of the 'Chromat' in being entirely made of the prism material and consequently requiring inclination of the plate to bring the spectrum into focus. This lens, which will be more fully discussed later, gives, at an aperture ratio of  $f5.6$ , excellent definition and a flat field. The above remarks apply to a dispersion of three prisms for which this type is especially adapted. If it were used with one prism, in addition to the limitations as to aperture, the plate inclination required (about  $50^{\circ}$ ) would be inconvenient and practically inadmissible in radial velocity work.

There are consequently required short-focus objectives giving a flat field with three prisms, and objectives giving a flatter field than the regular triplet with a single prism. This need, together with what had already been accomplished by Hartmann and Zeiss, was laid before the J. A. Brashear Co. who, with their usual willingness, put their best efforts at our disposal and, in collaboration with Prof. Hastings, produced two eminently successful objectives. In both of these the employment of one kind of glass only is followed, although not, as in the 'Chromat,' of the same material as the prisms, and the consequent chromatic differences in focus are overcome by inclining the plate. The objective first produced, to which they have given the name 'Single Material' is composed of two widely separated positive elements of crown glass of the lowest dispersion and is especially adapted for use with one prism, giving exquisite definition and a field flat within 0.1mm. over the whole visible and considerably into the ultra-violet spectrum. The other is similar to the 'Chromat' in form but made of light crown glass, giving also a flat field and good definition with three prisms with a plate inclination of only slightly over half that of the 'Chromat.'

The limiting aperture ratio of the former of these objectives is about  $f8$ , of the latter  $f12$ , so that evidently they can not supply the need of short-focus lenses of  $f6$  or thereabouts for either single or three-prism work.

The only prospect of success in this respect seemed to lie in some of the modern anastigmat photographic lenses, and a number of different makes were accordingly obtained for trial. The definition of several of these, though good enough for ordinary

\* Zeitschrift für Instrumentenkunde, September, 1904.

photographic work, would not stand the critical test of spectrum photography owing probably to some residual spherical aberration. Two, however, the Ross 'Homocentric' and the Zeiss 'Tessar,' gave good definition and the forms of their fields were accordingly determined.

It may not be out of place to give a brief description of the method employed in determining the fields of the ten lenses tested. The dispersion for eight of them was produced by the Ottawa spectrograph, having the following optical constants:—Hastings 'Isokumatic' collimator objective of 35mm. aperture and 525mm. focus; one or three prisms of Jena glass O. 102, angles  $63^{\circ} 50'$  each; ray at minimum deviation  $\lambda 4415$ . Two of the objectives were tested with a new single-prism spectrograph having 'Isokumatic' collimator of 51mm. aperture and 763mm. focus, O. 102 prism of angle  $63^{\circ} 30'$ , ray at minimum  $\lambda 4325$ .

The positions of focus in different parts of the field were determined by a modification of Hartmann's method\* of extra-focal exposures. By means of a revoluble semi-circular diaphragm behind the collimator lens and an occulting diaphragm in front of the slit, a narrow strip of spectrum, photographed through the half of the prisms near the refracting edge, was placed between and touching two narrow strips made through the base half of the prisms. Evidently, when the plate is in the focus of the camera lens for any particular line in the spectrum, the adjacent portions of this line will be continuous, while, if not in focus, the central section will be displaced to red or violet of the outside sections, the direction and magnitude of this displacement giving a measure of the position of the focal point for the line in question. Two such plates, one inside and one outside the focus, will suffice to determine the form of the field. In order to avoid the labour of measurement and computation and on account of the diffuseness of the lines and consequent inaccuracy of measurement, when the plate is more than a millimetre from the focus, I have generally preferred to make a number of spectra, by the method outlined above, at camera settings about 0.25mm. apart within and without the focus. Five of these have in general sufficed to determine the focal curve and, as the camera back can be moved laterally, they can all be made on one plate, thus allowing ready comparisons. Simple inspection of these spectra under a microscope or even by a hand magnifier enables the focus of any line to be determined to about 0.05mm. by observing at which of two successive spectra the central section has opposite displacements with respect to the outside sections. Interpolation to the above accuracy can then generally be made. This takes only one-tenth the time and is probably equally as accurate as the method of measuring the displacements and computing the distance from focus. I may say that the camera setting in our regular work is always determined in this way, enabling the plate to be certainly placed considerably within 0.1mm. of the true focus.

This method is probably open to the objection that it will not give the true focal point when the system has aberration, but it must be remembered that, to prevent systematic displacements in radial velocity work due to non-uniform illumination of the collimator objective, this method, which determines the focus by the absence of such displacement, is certainly the one that should be used. Moreover, in this case tests at full aperture, so far as the focus can be determined by definition, confirmed the results of the former method, and there is no reason to doubt the accuracy of the focal curves determined.

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\* Zeitschrift für Instrumentenkunde, 24, 1, 1904.



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The following ten lenses, given in the order of procuring and testing, were tested for their curvature of field.

## OBJECTIVES TESTED FOR FIELD.

| Number | Objective.                     | Aperture. | Focal Length. | Tested with dispersion of |
|--------|--------------------------------|-----------|---------------|---------------------------|
| 1....  | Brashear Single Material. .... | 45        | 525           | 1 Prism, 3 Prisms.        |
| 2....  | Zeiss Chromat. ....            | 45        | 525           | 3 Prisms.                 |
| 3....  | Ross Homocentric. ....         | 40        | 254           | 3 Prisms.                 |
| 4....  | Zeiss Tessar. ....             | 48        | 305           | 3 Prisms.                 |
| 5....  | Brashear Light Crown. ....     | 45        | 525           | 3 Prisms.                 |
| 6....  | " Telescope Flint. ....        | 45        | 525           | 3 Prisms.                 |
| 7....  | " O. 102 ("Chromat"). ....     | 45        | 375           | 3 Prisms.                 |
| 8....  | " Triplet. ....                | 57        | 480           | New 1 Prism, 3 Prisms.    |
| 9....  | " Single Material. ....        | 57        | 457           | New 1 Prism.              |
| 10.... | Ross Special Homocentric. .... | 40        | 254           | 3 Prisms.                 |

The form of field of each of the lenses is given in the accompanying figures where the horizontal lines represent differences of focus of one millimetre, the wave length and angular distance from the optical axis are shown by the vertical lines, and the diameters of the circles representing the observed points are 0.2mm. Wherever the curves are not horizontal indicates that the inclination of the plate holder required changing slightly, but this of course has no effect on the form of the field. In order to group the curves according to the type and purpose of the objectives, the order given in the above table has been changed and those of longer focus used with a dispersion of three prisms will be first considered (Fig. 6).

*Brashear Single Material (No. 1).*

This consists of two simple converging lenses, the front double convex, the rear convex meniscus, of crown glass of lowest index, separated by nearly one-third the focal length. As will be seen later, this objective gives a beautiful field with one prism, but is strongly concave towards the lens with three prisms, with about the same curvature of field as the regular Hastings Triplet. The inclination of the plate towards the violet is slightly over  $5^{\circ}$ . Allowing deviation from focus of 0.1mm., slightly over  $2^{\circ}$  of field is usable.

*Zeiss Chromat (No. 2).*

This consists of two strongly curved meniscus elements of Jena glass O. 102, the front diverging, the rear converging and of about half the focus of the combination. When received it gave a field convex towards the lens as shown in the upper curve. When the separation between the elements was increased from 2.25 to 4.5mm. the field became almost absolutely flat over the whole  $8^{\circ}$ , giving at the same time excellent definition. Inclination of the plate towards the violet about  $16^{\circ}$ .

*Brashear Light Crown (No. 5).*

This is a lens of the same form as the 'Chromat' except that it is made of light crown glass. With the original separation the field was concave but became flat on decreasing the separation from 4.8 to 3.2mm. This change in separation resulted in loss of defining power. The objective was re-figured at the new separation and gave good definition and field flat over practically the whole range. Inclination of plate to the violet about  $9^{\circ}$ .

*Brashear Telescope Flint (No. 6).*

An objective similar to the previous one only made of telescope flint glass. The field was originally convex but became flat on increasing the separation from 4.8 to 7.9mm. Refiguring did not give so much improvement as in the light crown objective. Field is now practically flat. Inclination of plate to the violet is about  $13.5^\circ$ .

*Brashear Triplet (Hastings) (No. 8).*

This is a lens of the same type as used in the Mills, Bruce and Lowell spectrographs. The field is, as shown, strongly concave towards the objective with a usable portion, allowing deviation of 0.1mm., of about  $2.5^\circ$ . The definition at the centre of the field is about the same as in the 'Chromat,' but towards the margins even when in focus is much inferior.

All the above objectives are of relatively long focus, small angular aperture, about  $f$  12, tested with dispersion of three prisms. Let us now examine the fields given by shorter focus objectives, using the same dispersion (Fig. 7).

*Ross Homocentric (No. 3).*

This standard photographic objective gives good definition but a strongly concave field. An increase in separation from 59 to 124mm. appears to flatten the field, but at the expense of defining power and the lens is not usable at the increased separation. Useful field is not more than  $2^\circ$ .

*Zeiss Tessar (No. 4).*

This objective was one of the standard form taken from the stock of Bausch and Lomb. It gives good definition and a field very slightly convex. This convexity is removed by an increase in separation from 41.0 to 41.7mm., but with a slight loss in defining power, so that it is probably preferable to use it at the normal separation. Another lens of the same series, aperture, and focus was tested, giving practically the same field but considerably poorer definition. This is of interest as showing the differences between the performance of two objectives presumably identical and indicates the desirability of specially selecting and testing the lens to be used from a number.

*Brashear O. 102 ('Chromat') (No. 7).*

This objective of the same type and material as the Zeiss Chromat but of larger angular aperture, gives a field nearly flat with a separation of 6.3mm., but with poor definition even after refiguring. This shows that this type can not be successfully constructed of larger aperture ratio than  $f$ 11, say. Inclination of the plate to the violet about  $16^\circ$ .

*Ross Special Homocentric (No. 10).*

This objective was, by the kindness of the makers, Messrs. Ross, Limited, especially computed and constructed for us. It has an aperture ratio of  $f$ 5.6, is of practically the same form as their Homocentric, but with all four elements of O. 102 glass. It gives beautiful definition and a field nearly flat, usable over  $8^\circ$ . Change of separation is without appreciable effect on the form of field. Inclination of plate to the violet about  $16^\circ$ .

Two types of objectives of medium and long focus have been tested with a dispersion of one prism (Fig. 8).

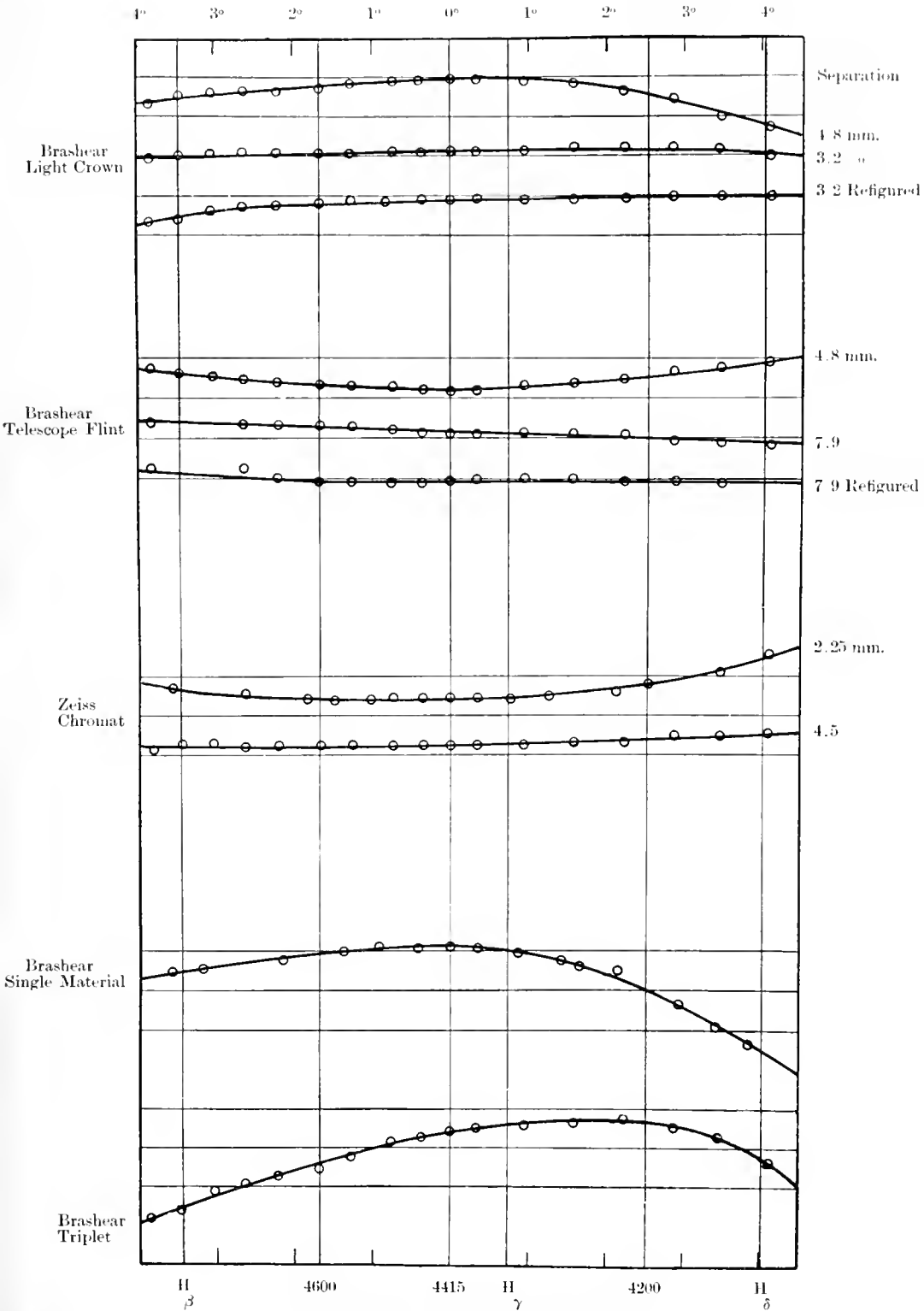


FIG. 6—Long Focus Objectives with three prisms.



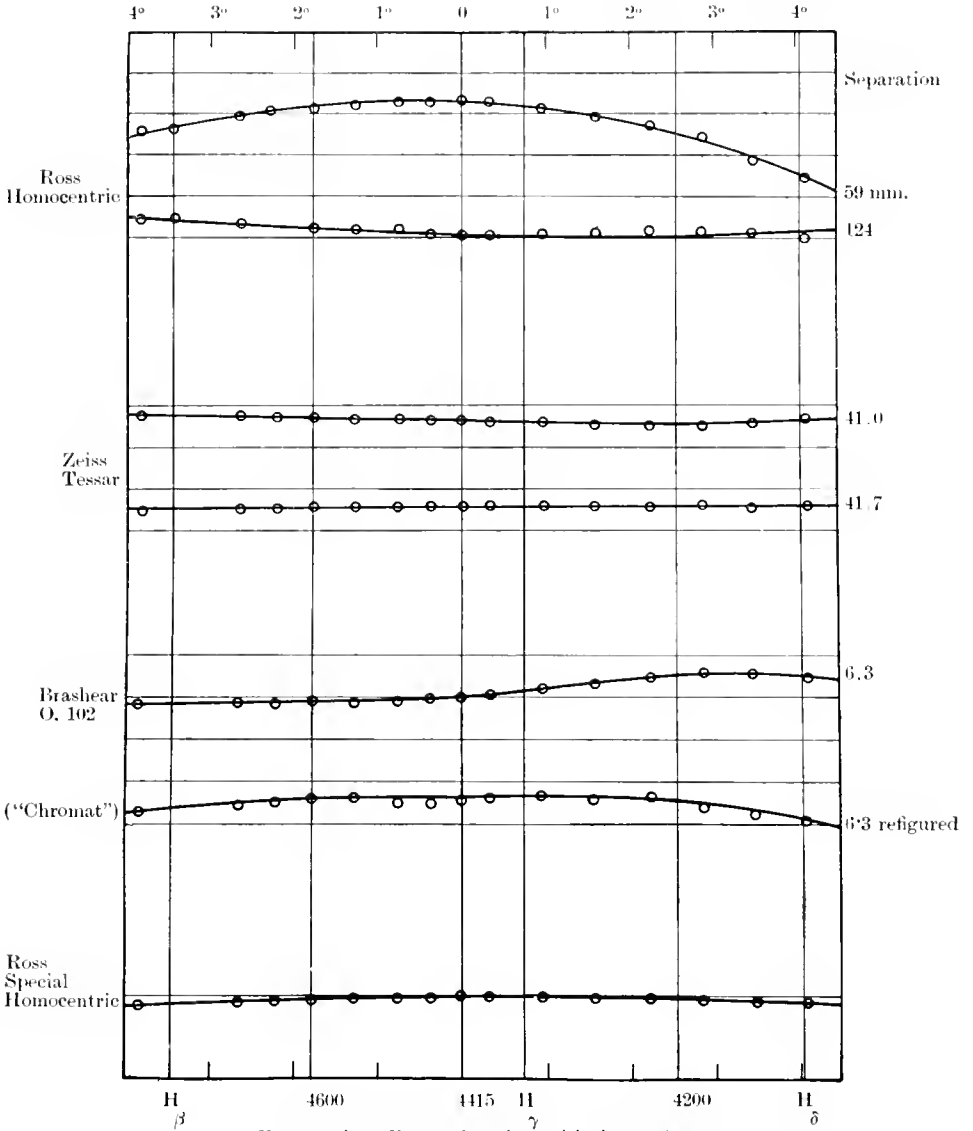


FIG. 7.—Short Focus Objectives with three prisms.



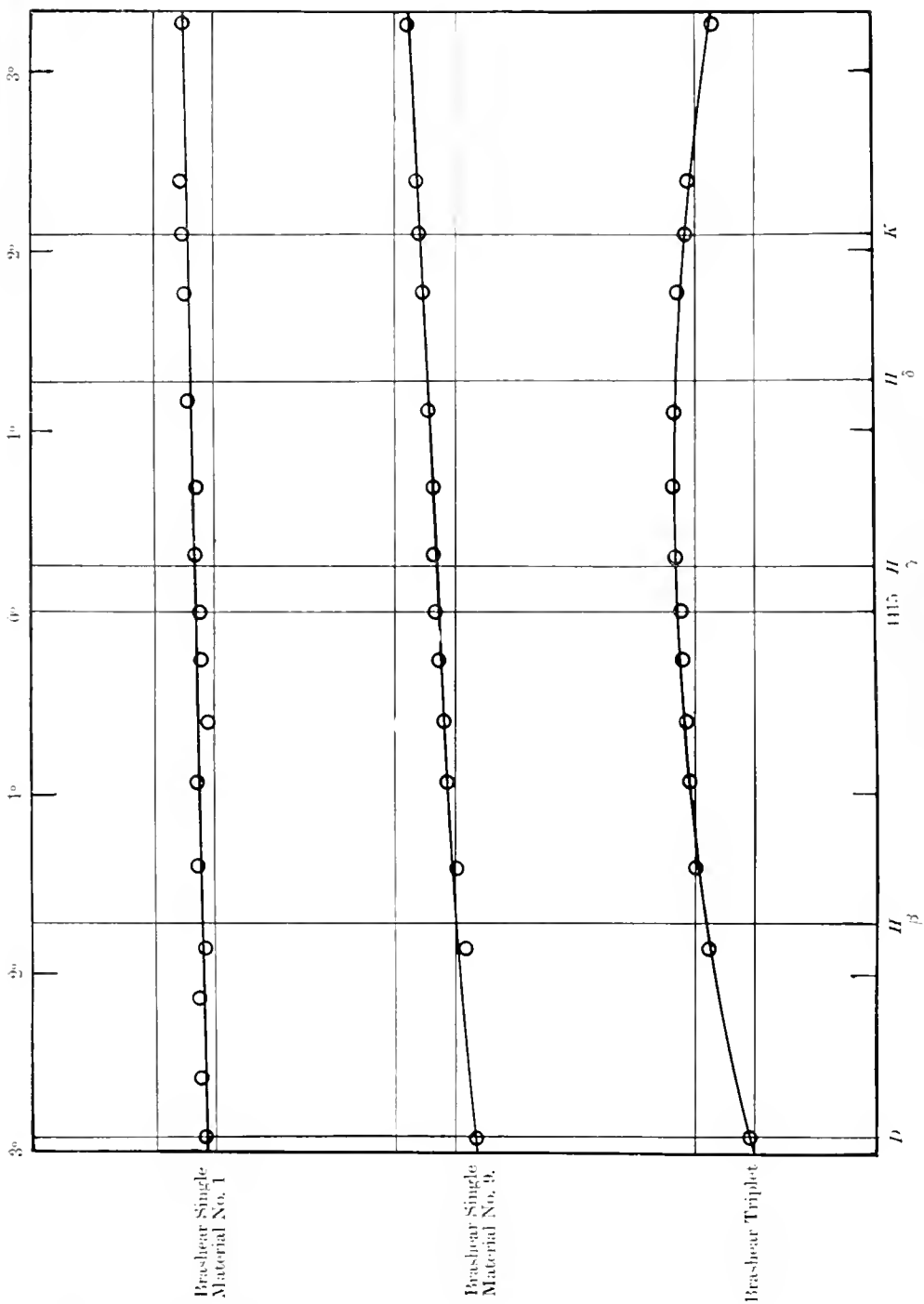


FIG. 8.—Objectives tested with one prism.





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*Brashear Single Material (Nos. 1 and 9).*

Both of these objectives, whose form was described above, are of the same type, No. 1 of an aperture ratio  $f/11.5$ ; No. 9,  $f/8$ . When used with three prisms they give the strongly concave field shown in Fig. 6, but with a single prism the field is almost absolutely flat over the whole range of visible and as far into the ultra-violet spectrum as the prism will transmit. The definition given is excellent and the objectives leave nothing to be desired for single-prism work. The inclination of plate to the violet is about  $16^\circ$ . I am glad to express here my appreciation of the efforts, as well as my admiration for the skill of Mr. McDowell in figuring these objectives. As both components are converging, the only means of removing the positive spherical aberration is by departure from spherical surfaces. While, as Mr. McDowell says, this was comparatively easy for No. 1, of the smaller angular aperture, it taxed even his skill to remove it entirely in the other, and it was only after a second trial and the use of a special device that the objective was finally made perfect.

*Brashear Triplet (No. 8).*

This, as with three prisms, gives a field concave towards the objective but with considerably less curvature. The usable field is somewhat over  $2^\circ$ . Definition good.

The final results of the investigation may be summarized as follows:—

For a dispersion of three prisms with a camera of fairly long focus two objectives are much superior to the others, the Zeiss 'Chromat' and the Brashear Light Crown. The former gives a flatter field and slightly better definition than the latter, but on the other hand the smaller plate inclination of  $8^\circ$  instead of  $16^\circ$  and the smaller absorption of the Brashear are an advantage. The definition of either of these is fully equal to the regular triplet in the centre of the field and much superior at the margins.

For short-focus lenses with three prisms both the Zeiss 'Tessar' and the Ross 'Special Homocentric' give good definition and flat fields. The Ross can be used of shorter focus than the Tessar, and gives exquisite definition, but the field of the Tessar is flatter and the plate is normal to the axis.

In single-prism work the Brashear 'Single Material' is much superior to the type of Triplet usually employed, both in definition and extent of field and can not be surpassed or even equalled for its purpose.

## MEASUREMENT AND REDUCTION OF STELLAR SPECTRA.

With the exception of some plates measured on the spectro-comparator, which will be fully described below, all of the measurements have been made with the Toepfer microscope, and reduced by the modified Hartmann method previously described and explained. When the new single-prism spectrograph was brought into use it was found necessary to obtain tables, similar to those previously prepared, for the reduction of the spectrograms.

As before, plates of the comparison spectrum were made at three temperatures, as far separated as the time and season would permit, and these plates were measured.

From these measures the constants of the Hartmann interpolation formula  $\lambda - \lambda_0 = \frac{c}{s - s_0}$  were computed, using as the three standards different sets of lines, for the purpose of determining which would give the best agreement over the whole range of spectrum. It was not thought necessary, after the work of Mr. McLean, described in the 1907 report, to use the complete formula,

$$s_0 - s = \frac{c}{(\lambda - \lambda_0) a},$$

as he showed that with the previous single-prism instruments, the best agreement was given when  $a = 1$ .

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It was found that standards chosen at the middle and near the ends of the spectrum gave the best agreement on the whole and these, with the measures corresponding and the constants for the three temperatures, are given.

TABLE OF CONSTANTS.

| Temp.<br>C. | 4864 943 | 4341 162 | 3930 450 | $s_2$    | log $\sigma$ | $\lambda_s$ |
|-------------|----------|----------|----------|----------|--------------|-------------|
|             | $s_1$    | $s_2$    | $s_3$    |          |              |             |
| 2 8...      | 75·9840  | 50 9383  | 20 5074  | 176 9410 | 5·4249320    | 2229·851    |
| 8 6...      | 75 9851  | 50 9168  | 20 4543  | 176 9951 | 5·4250393    | 2230 595    |
| 15 6...     | 75·9557  | 50 8696  | 20 3763  | 176 9751 | 5·4248560    | 2231 943    |

Forming the differences between the  $s$ 's and the log. of the ratio we have:

| Temp.<br>C. | $s_1 - s_2$ | $s_2 - s_3$ | $s_1 - s_3$ | log $\frac{s_1 - s_2}{s_1 - s_3}$ |
|-------------|-------------|-------------|-------------|-----------------------------------|
| 2 8.....    | 25 0457     | 30 4309     | 55 4766     | 9 65462                           |
| 8 6.....    | 25 0683     | 30 4625     | 55 5308     | 9 65459                           |
| 15 6.....   | 25 0861     | 30 4933     | 55 5794     | 9 65452                           |

The changes in these differences and in the log. of the ratio are only about half those given with the other single-prism spectrograph. This is undoubtedly due to the fact that the camera setting remains unchanged with change of temperature in the new instrument, and, consequently, only the change in the angular dispersion appears, instead of that due to angular dispersion plus that due to increase in distance of the fœcal plane from the camera objective.

Averaging up the differences as far as possible, an increase of temperature of 1°C. increases  $s_1 - s_3$  by .008 revolution, and diminishes  $\log \frac{s_1 - s_2}{s_1 - s_3}$  by .00001.

Forming an arbitrary series with these differences from the last two columns of the previous table, keeping them as close as possible to the observed values and computing 2nd and 3rd columns we have for differences of 10°.

| Temp.<br>C. | $s_1 - s_2$ | $s_2 - s_3$ | $s_1 - s_3$ | log $\frac{s_1 - s_2}{s_1 - s_3}$ |
|-------------|-------------|-------------|-------------|-----------------------------------|
| -10.....    | 25 0070     | 30 3675     | 55 3745     | 9 65475                           |
| 0.....      | 25 0376     | 30 4169     | 55 4545     | 9 65465                           |
| +10.....    | 25 0681     | 30 4664     | 55 5345     | 9 65455                           |
| +20.....    | 25 0985     | 30 5160     | 55 6145     | 9 65445                           |

Again, taking the arbitrary equidistant values of  $s_3$  for these four temperatures, which make the micrometer reading for the iron line at minimum deviation  $\lambda 4325.9$

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as near as possible to 50.0000, we obtain the following values for  $s_1$ ,  $s_2$ ,  $s_3$  and from them the three constants of the formula:—

| Temp.<br>C.  | $s_1$   | $s_2$   | $s_3$   | $s_4$    | log e     | $\lambda_2$ |
|--------------|---------|---------|---------|----------|-----------|-------------|
| -10. . . . . | 75.9260 | 50.9190 | 20.5515 |          |           |             |
| 0. . . . .   | 75.9516 | 50.9200 | 20.5031 | 176.9129 | 5.4250327 | 2229.197    |
| +10. . . . . | 75.9891 | 50.9210 | 20.4546 | 176.9736 | 5.4248342 | 2231.163    |
| +20. . . . . | 76.0205 | 50.9220 | 20.4060 | 177.0327 | 5.4246277 | 2233.137    |

From these constants were computed the micrometer readings for all the star and comparison lines employed, and in addition the velocities corresponding to one revolution of the micrometer screw for each star line. This latter is obtained by differentiating the dispersion formula and applying Doppler's principle resulting in

$$v = \frac{299860}{\lambda} \cdot \frac{(\lambda - \lambda_0)^2}{c}$$

The velocities per revolution, as compared with those for the original single prism, are given for a few lines below to give some indication of the difference in dispersion.

*Velocities per Revolution.*

Temperature + 10°C.

| Wave Length. | Old One Prism. | New One Prism. |
|--------------|----------------|----------------|
| 4861.527     | 1454.4         | 1604.5         |
| 4713.308     | 1336.6         | 1473.7         |
| 4549.766     | 1209.0         | 1332.1         |
| 4481.400     | 1156.5         | 1273.9         |
| 4395.286     | 1091.1         | 1201.3         |
| 4340.634     | 1050.1         | 1155.8         |
| 4260.640     | 990.6          | 1089.9         |
| 4202.161     | 947.7          | 1042.3         |
| 4143.928     | 905.4          | 995.4          |
| 4101.890     | 875.2          | 961.9          |
| 4026.352     | 821.5          | 902.4          |
| 3970.177     | 728.1          | 858.3          |
| 3933.825     | 756.0          | 830.9          |

These velocities show that the new instrument has very approximately ten per cent less linear dispersion than the old. This, of course, is due almost entirely to the shorter focus camera lens used, as the prisms are nearly alike and the angular dispersion similar.

*The Spectro-comparator.*

The Spectro-comparator, which was briefly referred to in my last report, has not been used except on a few plates of  $\beta$  Geminorum more to test the capabilities of the instrument than for the purpose of obtaining definite measures of the velocity of this star. Before giving these measures, however, it may be well to shortly describe the instrument, its principle and the methods of measurement. These have been very fully described by its inventor, Dr. Hartmann, in the publications of the Astrophysical Observatory of Potsdam, Volume XVIII., Part 1, and consequently need not be gone into in great detail here.

The principle of measurement depends upon the direct comparison in a special form of double image microscope of the star spectrum, whose velocity is required with a standard spectrum of the sun, whose velocity at the instant the spectrum was made.

can be readily computed. The difference in the displacements of the star and the sun lines with respect to the same metallic comparison lines on each plate is measured by a micrometer screw, and this linear displacement can be at once converted into kilometres by multiplication by a known or easily computed constant. By adding to this radial velocity that of the sun with respect to the earth, with the proper sign, we obtain the velocity of the star with respect to the earth, and this can be readily reduced to the sun in the well known way.

The instrument of which a photograph is shown in Fig. 9 and diagrams in Figs. 10 and 11 was constructed by Zeiss in a very workmanlike manner. It consists essentially of a table  $T$ , Fig. 10, which carries at  $E_1$  and  $E_2$  the standard solar and the star spectrum respectively, and of a single ocular double objective microscope carried above the table on the bracket  $R$ , Fig. 11, which combines and compares the images of the two spectra.

The table  $T$ , which as Fig. 11 shows, is inclined at  $45^\circ$  to the horizontal for convenience in measuring, slides at its lower portion on the steel cylinder  $Z$  35mm. diameter and at its upper part on the steel bar  $J$ . It is moved on these bearings over a range of 12cm. by rack and pinion of which the knurled wheel is shown at  $K$  and is clamped in any position, read off on the scale and vernier  $N$ , by the clamp screw near  $K$ . At the upper part of the table a carriage  $B_2$  slides transversely in ways, adjustment being made by the screw  $G$ , while a secondary carriage  $A_2$ , having a slit 1cm. wide and 12cm. long, through which the star spectrum is illuminated by the plane mirror shown in Fig. 11 is oriented by the tangent screw  $D_2$  and the opposing spring  $F_2$ , so that the spectrum, clamped on it may be placed parallel to the motion of the table  $T$ . The carriage  $B_1$ , which carries the standard or fundamental solar spectrum, has an orienting table  $A_1$ , adjusted by the screw  $D_1$  and spring  $F_1$ , and slides in ways parallel to the motion of the table  $T$ . It is moved by means of the micrometer screw  $S$  of 0.5mm. pitch, having a range of movement slightly over 2cm. The head is divided into 100 parts so that the movement of the sun spectrum can be read direct to 0.005mm. and estimated to 0.0005mm.

The double microscope, Fig. 11, by which these two spectra are observed is supported by the bracket  $R$  on which the arm  $R_1$  slides, moved by the screw  $H$ , the position being read on the scale  $W$ . The tubes carrying the objectives  $O_1 O_2$  are attached at a fixed distance from one another to a plate  $L$ , movable in ways on the arm  $R_1$  by the screw  $Q$ . At the upper ends of the objective tubes, which are provided with rack and pinion movement for focussing, are the prisms  $P_1 P_2$ , which reflect the light from the spectra on  $E_1$  and  $E_2$  to the compound prism  $P_3 P_4$ . On the hypotenuse of the prism  $P_4$  is a surface silvered in the form shown in Fig. 12, and the two prisms are then

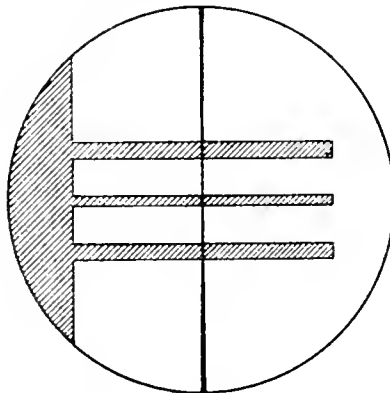


Fig. 12.

cemented together with Canada Balsam. The proper proportioning of the widths of the silver strips enables one to see, on looking through the eyepiece, a narrow strip of

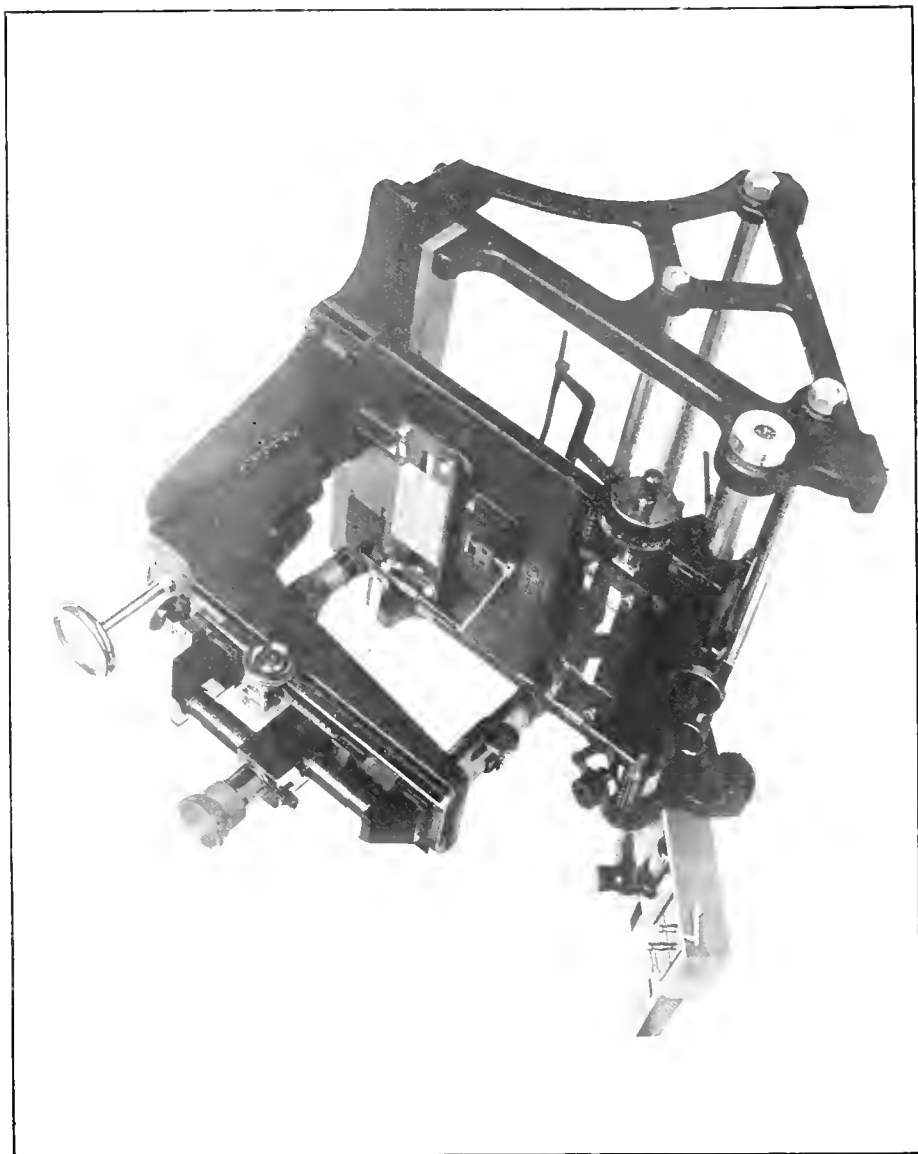


FIG. 9. Spectro-Comparator.



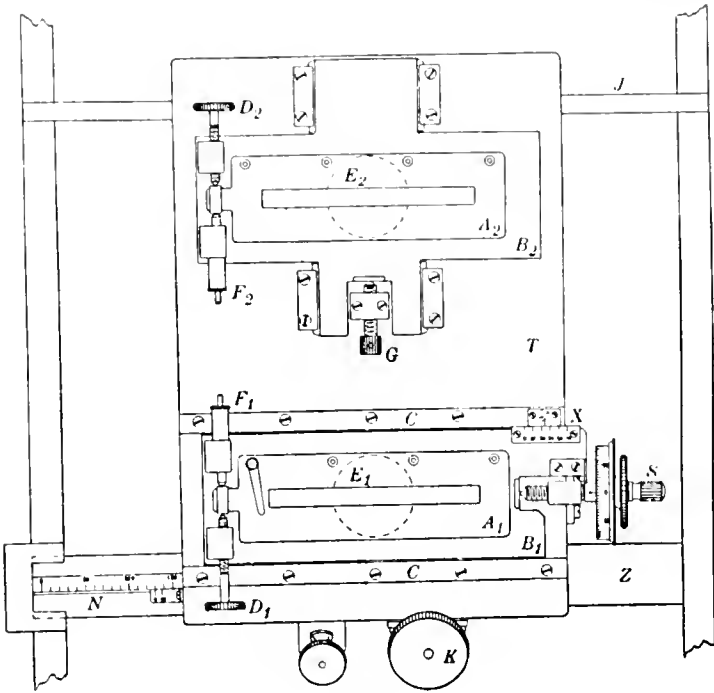


FIG. 10.

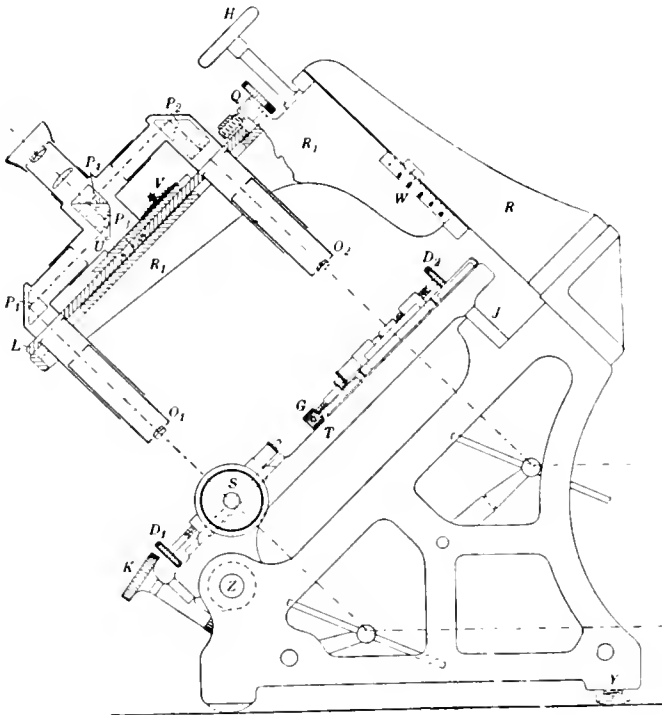


FIG. 11.





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star spectrum between and touching two strips of sun spectrum, and also on either side a narrow strip of the star comparison between and touching strips of sun comparison spectrum. The compound prism  $P_2 P_1$ , with the eyepiece, is carried on a slide  $U$  moved by rack and pinion  $V$ , so that the distance between the eyepiece and the objectives and consequently the magnification of the two spectra may be changed at will. This is to enable them, even though of different dispersions, to be made apparently identical in the field and hence readily and accurately comparable.

The adjustment of the spectra on the machine is a comparatively simple matter, only taking a few moments. The standard or fundamental solar spectrum usually made on a lantern or process plate in order to obtain sufficient contrast, is placed on its carriage, and clamped by a pair of spring microscope clamps. The carriage is then moved by the pinion  $K$  until the centre of rotation of the orienting arrangement is directly under the microscope 1, which is in this case at the reading 132.3 on the scale  $N$ .

The whole microscope system is now moved by the screw  $Q$  until the solar spectrum is centrally situated with respect to the central silver strip in the field. By moving the carriage back and forwards the spectrum can be rapidly oriented. The star spectrum may be similarly oriented while it is made central by the screw  $G$ . There then remains only to adjust the magnification of the separate spectra, the comparison lines of the two appear coincident in the whole extent of the field of view. By moving the ocular by the rack and pinion  $V$ , the magnification of one spectrum is increased and of the other decreased. This will evidently disturb the focus, but this can be easily corrected by adjusting the objectives  $O_1$  and  $O_2$  by their focussing screws seen in Fig. 9. This will again slightly change the magnification and the process may need to be repeated, but a little practice soon enables one to equalize the apparent dispersion very quickly.

Before making any measurements it is necessary to divide the fundamental solar spectrum into regions, indicated by small ink dots, and numbered for identification. These regions are so chosen that there is a slight overlapping of the field in adjacent regions with the magnification to be employed. The dots, which are brought under the wire in the measurement, are placed, as nearly as possible, in the centre of a group of good solar lines and at the same time so that the field includes a number of good comparison lines. The regions selected in a series of good fundamental solar spectra made on May 14, 1908, on Seed process plates are given in the following table. In addition in the third column of the table are given the velocities corresponding to one revolution of the micrometer screw. These velocities were computed from the measurement of lines on the fundamental spectrum by the micrometer screw of the comparator. These linear measurements were used to obtain the constants of the Hartmann formula, and from these constants the velocities corresponding to the wave length of each region were computed.

## CONSTANTS OF FUNDAMENTAL SPECTRA, 1519-1526.

Exposed May 14, 1908.

| No. of Region. | Wave Length. | Vel. per Rev. S. | No. of Region. | Wave Length. | Vel. per Rev. S. |
|----------------|--------------|------------------|----------------|--------------|------------------|
| 1              | 4867.0       | 582.1            | 14             | 4374.5       | 364.2            |
| 2              | 4867.0       | 535.4            | 15             | 4346.5       | 352.1            |
| 3              | 4754.0       | 531.9            | 16             | 4322.8       | 341.8            |
| 4              | 4769.6       | 512.0            | 17             | 4298.2       | 331.1            |
| 5              | 4669.0       | 494.0            | 18             | 4273.3       | 320.4            |
| 6              | 4628.7       | 476.0            | 19             | 4249.9       | 310.4            |
| 7              | 4590.2       | 459.1            | 20             | 4226.8       | 300.6            |
| 8              | 4554.6       | 443.2            | 21             | 4206.0       | 291.7            |
| 9              | 4523.9       | 429.7            | 22             | 4184.3       | 282.1            |
| 10             | 4492.0       | 415.7            | 23             | 4157.2       | 271.2            |
| 11             | 4460.3       | 401.7            | 24             | 4139.5       | 263.4            |
| 12             | 4429.6       | 388.3            | 25             | 4117.8       | 255.7            |
| 13             | 4402.1       | 376.2            | 26             | 4099.0       | 246.7            |

$$\text{Log } f = \log. \frac{1}{2 \sum \frac{1}{\lambda}}$$

| Region. | 3       | 4       | 5       | 6       | 7       |
|---------|---------|---------|---------|---------|---------|
| 13      |         |         | 1.37646 | 1.42045 | 1.47137 |
| 14      |         |         | 1.32312 | 1.36175 | 1.40594 |
| 15      |         | 1.24332 | 1.27409 | 1.30846 | 1.34727 |
| 16      | 1.17577 | 1.20095 | 1.22877 | 1.25961 | 1.29412 |
| 17      | 1.13813 | 1.16116 | 1.18647 | 1.21436 | 1.24533 |
| 18      | 1.10239 | 1.12355 | 1.14671 | 1.17207 | 1.20008 |
| 19      | 1.06833 | 1.08786 | 1.10914 | 1.13236 | 1.15784 |
| 20      | 1.03576 | 1.05385 | 1.07349 | 1.09483 | 1.11815 |
| 21      | 1.00457 | 1.02139 | 1.03958 | 1.05928 | 1.08072 |
| 22      | 0.97452 | 0.99028 | 1.00710 | 1.02535 | 1.04514 |
| 23      | 0.94533 | 0.95996 |         |         |         |
| 24      | 0.91718 | 0.93098 |         |         |         |
| 25      | 0.88998 | 0.90283 |         |         |         |
| 26      | 0.86348 | 0.87555 |         |         |         |

The magnification of the two spectra may be varied between about 10 and 40 fold by means of two pairs of objectives and three oculars. Moreover, by suitably varying these the silver strips on the prism may be varied in apparent width to suit star spectra of different widths. It has been found that a magnification of about 20 seems to give better and easier measurements than either higher or lower powers, and it has generally been used, although tests have been made with different powers.

When the plates have been adjusted as described above, the line in the centre of the field is set on the dot towards the red end at which it is deemed advisable the measurement should begin. This is determined by the appearance of the star spectrum and of its comparison lines. It has not been generally taken lower down than No. 5 at wave length  $\lambda 4669$ , as below that the comparison spectrum is not so good and no gain in accuracy would result. Towards the violet end the measurement is carried until the star spectrum becomes too weak for accurate comparisons, frequently about dot 20, wave length  $\lambda 4227$ . However, in a well exposed star spectrum the measurement could be extended over the whole range on the plate from  $H\beta$  to  $H\delta$ , although in my opinion nothing would be gained in accuracy by such procedure over that obtained by the use of a less number, say 12 or 15 regions. The measurement proceeds according to a regular scheme of alternation of star and comparison settings,

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so that at each region there are two settings on the star and two on the comparison lines, one by forward and one by backward rotation of the screw in each case. As soon as the measurement is completed, both star and fundamental spectra are reversed on the machine to overcome personality in the settings and the same regions are again measured.

It has been my experience that the most difficult part of the measurement is the determination of the point of coincidence of star and fundamental spectrum. Although with solar type stars of a considerable range in type, there is so little difference in the lines as to cause no trouble, nevertheless there are frequently apparently accidental irregularities in some of the lines in a region which render it difficult to determine the exact point of coincidence. The field extends over a considerable angle, and the eye can only observe at the most two or three lines at a time. These may be brought into the best coincidence, while lines in another part of the field may be better suited by a slightly different setting, and the best average is sometimes troublesome to obtain. These irregularities are chiefly due, I think, to irregular deposition of the silver grains in the comparatively coarse structure of the fast plates, to local distortions of the photographic film, to possibly non-uniform intensity of the star spectrum throughout its width and to other causes of a similar nature rather than to constant differences in the spectrum of star and sun. Such differences can be noted in the case of some lines, but these seem to be few compared with the accidental deviations observed. This difficulty does not exist to so great an extent with regard to the emission lines. Provided the comparison spectra are of nearly the same intensity, coincidences can be easily, quickly, and accurately obtained. The accidental deviations observed in the apparent positions of star lines serve to explain the comparatively high residual sometimes obtained in the direct measurement of good lines in solar type spectra.

After the measurement is completed the reduction of the separate measures to velocities is a simple matter. The difference in the settings for coincidence between emission and absorption spectra, multiplied by the velocity per revolution at the region under consideration gives the velocity at once. These differences are, however, tabulated for both positions of the plate, and the mean of the two for each region multiplied by the velocity factor gives the velocity for the region, while the velocity for the plate is obtained from the mean of the regions.

This considers all the regions as of equal weight, whereas such is not the case. In some parts of the spectrum the lines are more numerous or of better quality, and moreover as the dispersion increases, as we go towards the violet, greater weight should be given. There are then two courses open, to give weights according to the quality of the regions, increasing these as we go towards the violet, or to give weights proportional to the dispersion. The latter method is much simpler, and should give practically the same values as the more complex method and better values than the simple mean. Moreover, Hartmann has developed a very simple method of obtaining the velocity from the differences. If we call the differences with red to right  $d_1$  and with red to left  $d_2$ , then the mean  $d = \frac{1}{2} (d_1 + d_2)$ , which multiplied by the velocity factor  $s$ , gives velocity  $sd$  for the region. Its weight is proportional to  $\frac{1}{s}$ , and hence the

weighted mean velocity can be very simply represented by  $\frac{\sum d}{\sum \frac{1}{s}}$ . As  $d = \frac{1}{2} (d_1 + d_2)$  we

can avoid taking the means of the differences by changing it to  $\frac{\sum d_1 + \sum d_2}{2 \sum \frac{1}{s}}$ . If we take

the velocity values per revolution of the fundamental spectrum and form the expres-

sions  $\log \left( \frac{1}{2 \sum \frac{1}{s}} \right)$  between all the regions which are likely to be used, the only pro-

cedure necessary to obtain the weighted mean velocity is to add all the differences together and add to the logarithm of the sum the tabulated value of the above expression. To the velocity of which this sum is the logarithm, must be added the computed radial velocity of the sun when the spectrum was made, and we have the radial velocity of the star with respect to the earth, which reduced for diurnal and annual motion will give us the velocity with respect to the sun.

As mentioned previously, only a few plates of  $\beta$  Geminorum made with the three-prism spectrograph have been measured, principally as a test of the capabilities of the instrument. It can practically be used only with spectra of the second and third classes, those with numerous well defined lines, allied to the spectrum of the sun. Our single-prism spectrograph has been almost entirely employed on stars of early type spectra, which can not be economically or accurately measured with the spectro-comparator. However, work on some solar type spectroscopic binaries with a short-focus camera on the three-prism spectrograph is about to start, and for the measurement of such spectra the comparator is especially suited.

One spectrum of  $\beta$  Geminorum No. 1373, of only moderately good quality, was selected as a test plate and has been measured fifteen times with different fundamental spectra, different arrangements of objectives and oculars and with two different ocular prisms.

The measures and their summary given below enable an estimate of the accuracy obtainable in measurement to be formed. Further ten additional plates of  $\beta$  Geminorum have been measured with constant conditions in the comparator, which enables an estimate to be formed of the instrumental errors to be expected in the making of the spectra. These also with a summary are given below:—

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β GEMINORUM 1373.

SOLAR STANDARD 1360.

Observer (J. S. P.  
Measurer)

| Region. | $d_1$ | $d_2$ | $d$            | $V$   | $i$   |
|---------|-------|-------|----------------|-------|-------|
| 7       | 053   | 049   | 052            | 24 84 | 0 06  |
| 8       | 47    | 48    | 48             | 22 18 | -2 60 |
| 9       | 53    | 54    | 53             | 24 01 | -0 77 |
| 10      | 55    | 51    | 53             | 23 53 | -1 25 |
| 11      | 60    | 51    | 55             | 23 87 | -0 91 |
| 12      | 50    | 48    | 49             | 20 58 | -4 20 |
| 13      | 64    | 57    | 61             | 25 07 | -0 29 |
| 14      | 65    | 65    | 65             | 26 32 | -1 54 |
| 15      | 64    | 60    | 62             | 24 68 | -0 10 |
| 16      | 64    | 62    | 63             | 24 57 | -0 21 |
| 17      | 67    | 66    | 66             | 25 34 | 0 56  |
| 18      | 72    | 73    | 73             | 27 45 | 2 67  |
| 19      | 78    | 69    | 73             | 27 01 | 2 23  |
| 20      | 79    | 74    | 76             | 27 51 | 2 73  |
| 21      | 70    | 73    | 72             | 25 56 | 0 78  |
| 22      | 74    | 73    | 73             | 25 33 | -0 55 |
| 23      | 71    | 68    | 70             | 23 94 | 0 84  |
| 24      | 76    | 71    | 73             | 24 38 | -0 40 |
| 25      | 71    | 75    | 73             | 23 80 | 0 98  |
| 26      | 87    | 78    | 82             | 25 91 | -1 13 |
| 27      | 84    | 76    | 80             | 24 48 | -0 30 |
| 28      | 85    | 90    | 88             | 26 40 | -1 62 |
| 29      | 91    | 91    | 91             | 26 57 | 1 79  |
| 30      | 87    | 71    | 79             | 22 51 | 2 26  |
| 31      | 89    | 90    | 89             | 24 03 | -0 75 |
|         | 1758  | 1683  | Mean . . . . . | 24 78 | ..... |

$\Sigma d = 3441$   
 $V_s - V_o = - 24 85$   
 $V_a = - 0 21$   
 $V_d = - 21 97$   
 $Vd = - 0 16$

$\log = 53068$   
 $\log f = 85865$   
 $\log (V_s - V_o) = 1 39533$   
 $V = + 2 93$

$\epsilon = \pm 1 10$

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## 3 GEMINORUM 1373.

SOLAR STANDARD 1461.

Observer J. S. P.  
Measurer 1

| Region | $d_1$ | $d_2$ | $d$       | $V$   | $v$   |
|--------|-------|-------|-----------|-------|-------|
| 1      | 049   | 051   | 050       | 24.90 | -0.32 |
| 2      | 49    | 51    | 50        | 24.21 | -0.37 |
| 3      | 48    | 47    | 48        | 22.61 | -1.97 |
| 4      | 48    | 51    | 49        | 22.56 | -2.02 |
| 5      | 50    | 55    | 53        | 23.84 | -0.74 |
| 6      | 54    | 51    | 52        | 22.85 | -1.73 |
| 7      | 52    | 53    | 53        | 22.76 | -1.82 |
| 8      | 57    | 57    | 57        | 23.88 | -0.70 |
| 9      | 59    | 63    | 61        | 24.99 | -0.41 |
| 10     | 64    | 62    | 63        | 25.21 | -0.62 |
| 11     | 66    | 65    | 65        | 25.43 | -0.85 |
| 12     | 68    | 65    | 66        | 25.25 | -0.67 |
| 13     | 70    | 67    | 69        | 25.87 | -1.29 |
| 14     | 73    | 70    | 71        | 26.04 | -1.46 |
| 15     | 64    | 70    | 67        | 24.05 | -0.53 |
| 16     | 68    | 73    | 71        | 24.94 | -0.36 |
| 17     | 72    | 72    | 72        | 24.80 | -0.22 |
| 18     | 74    | 72    | 73        | 24.60 | -0.02 |
| 19     | 75    | 74    | 74        | 24.43 | -0.15 |
| 20     | 76    | 82    | 79        | 25.55 | -0.97 |
| 21     | 82    | 80    | 81        | 25.62 | -1.04 |
| 22     | 78    | 80    | 79        | 24.47 | -0.11 |
| 23     | 85    | 84    | 84        | 25.48 | -0.30 |
| 24     | 78    | 87    | 83        | 24.68 | -0.10 |
| 25     | 93    | 82    | 88        | 25.55 | -0.97 |
|        | 1652  | 1658  | Mean..... | 24.58 | ..... |

$$\Sigma d = 3310$$

$$\log = .51983$$

$$\log f = .87155$$

$$\log (Vs - V_o) = 1.39138$$

$$Vs - V_o = -24.63$$

$$V_o = -0.32$$

$$V_a = -21.97$$

$$V.d = -0.16$$

$$r = \pm 0.71$$

$$V = -3.02$$

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$\beta$  GEMINORUM 1373.

SOLAR STANDARD 1461.

Observer J. S. P.  
Measurer J.

| Region. | $d_1$ | $d_2$ | $d$       | $f$   | $v$   |
|---------|-------|-------|-----------|-------|-------|
| 3       | 655   | 651   | 653       | 24.96 | -1.96 |
| 4       | 45    | 52    | 48        | 22.10 | +1.80 |
| 5       | 47    | 53    | 50        | 22.49 | -1.41 |
| 6       | 50    | 47    | 49        | 21.53 | +2.37 |
| 7       | 53    | 53    | 53        | 22.76 | -1.14 |
| 8       | 49    | 51    | 50        | 20.95 | -2.95 |
| 9       | 58    | 63    | 60        | 24.58 | -0.68 |
| 10      | 64    | 62    | 63        | 25.21 | -1.31 |
| 11      | 66    | 59    | 60        | 23.47 | +0.43 |
| 12      | 65    | 61    | 63        | 24.10 | -0.20 |
| 13      | 67    | 62    | 64        | 24.00 | -0.10 |
| 14      | 68    | 72    | 70        | 25.68 | -1.78 |
| 15      | 69    | 62    | 66        | 23.69 | +0.21 |
| 16      | 79    | 65    | 72        | 25.29 | -1.39 |
| 17      | 68    | 69    | 69        | 23.78 | +0.12 |
| 18      | 68    | 76    | 72        | 24.26 | -0.36 |
| 19      | 74    | 74    | 74        | 24.43 | -0.53 |
| 20      | 74    | 72    | 73        | 23.61 | +0.29 |
| 21      | 77    | 74    | 75        | 23.72 | +0.18 |
| 22      | 78    | 79    | 78        | 24.16 | -0.26 |
| 23      | 79    | 81    | 80        | 24.26 | -0.36 |
| 24      | 88    | 83    | 86        | 25.57 | -1.67 |
| 25      | 91    | 82    | 86        | 24.97 | -0.07 |
|         | 1526  | 1503  | Mean..... | 23.90 | ..... |

$$\begin{aligned} \Sigma d &= 3029 & \log &= .48130 \\ & & \log \bar{f} &= .89871 \\ V_s - V_o &= + 23.99 & \log (V_s - V_o) &= 1.38001 & v &= \pm 0.81 \\ V_o &= + 0.35 \\ V_a &= - 21.97 \\ V_d &= - 0.16 & V &= + 2.23 \end{aligned}$$

3 GEMINORUM 1373

SOLAR STANDARD 1462.

Observer J. S. P.  
Measurer j

| Station. | $d_1$ | $d_2$ | $d$   | $V$    | $v$   |
|----------|-------|-------|-------|--------|-------|
| 4        | 049   | 049   | 049   | 22.56  | -2.12 |
| 5        | 52    | 51    | 51    | 22.94  | -1.44 |
| 6        | 53    | 54    | 54    | 23.73  | +0.65 |
| 7        | 60    | 57    | 58    | 24.91  | -0.53 |
| 8        | 53    | 52    | 53    | 22.21  | +2.16 |
| 9        | 64    | 57    | 60    | 24.58  | -0.20 |
| 10       | 65    | 61    | 63    | 25.21  | -0.83 |
| 11       | 67    | 64    | 66    | 25.82  | -1.44 |
| 12       | 63    | 67    | 65    | 24.87  | -0.49 |
| 13       | 68    | 69    | 68    | 25.50  | -1.12 |
| 14       | 73    | 70    | 72    | 26.41  | -2.03 |
| 15       | 67    | 64    | 65    | 23.34  | -1.04 |
| 16       | 67    | 67    | 67    | 23.54  | -0.84 |
| 17       | 68    | 73    | 71    | 24.47  | -0.09 |
| 18       | 73    | 71    | 72    | 24.26  | -0.12 |
| 19       | 69    | 70    | 69    | 22.78  | -1.60 |
| 20       | 76    | 74    | 75    | 24.26  | -0.12 |
| 21       | 83    | 83    | 83    | 26.25  | -1.87 |
| 22       | 78    | 84    | 81    | 25.09  | -0.71 |
| 23       | 79    | 79    | 79    | 23.96  | -0.42 |
| 24       | 81    | 82    | 81    | 24.08  | -0.30 |
| 25       | 89    | 87    | 88    | 25.59  | -1.21 |
|          | 1497  | 1485  | Mean. | -24.38 |       |

$\Sigma d = 2992$

$\log = .47451$   
 $\log f = .91356$   
 $\text{Log } (V_s - V_o) = 1.38807$

$r = + 0.81$

$V_s - V_o = - 24.44$   
 $V_o = - 0.54$   
 $V_a = - 21.97$   
 $V_d = - 0.16$

$V = + 2.85$



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♄ GEMINORUM 1873.

SOLAR STANDARD 1462.

(Observer J. S. P.  
Measurer )

| Region. | $d_1$ | $d_2$ | $d$  | $V$   | $v$   |
|---------|-------|-------|------|-------|-------|
| 1       | 652   | 651   | 651  | 25.40 | +0.72 |
| 2       | 48    | 49    | 49   | 24.72 | +0.96 |
| 3       | 55    | 50    | 52   | 24.50 | +0.13 |
| 4       | 47    | 47    | 47   | 21.64 | +3.04 |
| 5       | 50    | 54    | 52   | 23.39 | +1.29 |
| 6       | 52    | 51    | 52   | 22.85 | +1.83 |
| 7       | 60    | 54    | 57   | 24.48 | +0.20 |
| 8       | 58    | 57    | 57   | 23.88 | +0.80 |
| 9       | 61    | 62    | 62   | 25.40 | -0.72 |
| 10      | 65    | 62    | 63   | 25.21 | -0.53 |
| 11      | 64    | 61    | 63   | 24.65 | +0.03 |
| 12      | 73    | 70    | 71   | 27.16 | -2.48 |
| 13      | 74    | 66    | 70   | 26.25 | -1.57 |
| 14      | 67    | 69    | 68   | 24.94 | -0.26 |
| 15      | 65    | 67    | 66   | 23.69 | +0.90 |
| 16      | 72    | 67    | 70   | 24.58 | +0.10 |
| 17      | 70    | 69    | 69   | 23.77 | +0.93 |
| 18      | 72    | 72    | 72   | 24.26 | +0.42 |
| 19      | 74    | 74    | 74   | 24.43 | -0.25 |
| 20      | 78    | 76    | 77   | 24.90 | -0.22 |
| 21      | 84    | 79    | 81   | 25.62 | -0.94 |
| 22      | 82    | 82    | 82   | 25.46 | -0.72 |
| 23      | 83    | 79    | 81   | 24.57 | +0.11 |
| 24      | 82    | 81    | 82   | 24.58 | +0.36 |
| 25      | 94    | 87    | 90   | 26.13 | -1.45 |
|         | 1682  | 1636  | Mean | 24.68 | ..... |

$\Sigma d = 3318$                        $\log = 32088$   
 $\log f = 87155$   
 $\log (V_s - V_o) = 1.39243$   
 $V_s - V_o = + 24.68$                        $v = \pm 0.77$   
 $V_o = + 0.48$   
 $V_a = 21.97$   
 $V_d = 0.16$                        $V = 3.03$

3 GEMINORUM 1373.

SOLAR STANDARD 1462.

Observer J. S. P.  
 Measurer J.

| Region. | $d_1$ | $d_2$ | $d$  | $V$   | $v$   |
|---------|-------|-------|------|-------|-------|
| 3       | 053   | 049   | 051  | 24.03 | -0.73 |
| 4       | 46    | 51    | 49   | 22.56 | +2.20 |
| 5       | 55    | 52    | 53   | 23.84 | -0.92 |
| 6       | 56    | 54    | 55   | 24.17 | +0.59 |
| 7       | 47    | 55    | 51   | 21.90 | +2.86 |
| 8       | 54    | 60    | 57   | 23.88 | -0.88 |
| 9       | 62    | 61    | 61   | 24.90 | -0.23 |
| 10      | 58    | 67    | 63   | 25.21 | -0.45 |
| 11      | 59    | 68    | 63   | 24.65 | +0.11 |
| 12      | 69    | 68    | 69   | 26.40 | -1.64 |
| 13      | 72    | 67    | 69   | 25.87 | -1.11 |
| 14      | 68    | 65    | 67   | 24.58 | +0.18 |
| 15      | 70    | 64    | 67   | 24.05 | +0.71 |
| 16      | 72    | 71    | 72   | 25.29 | -0.53 |
| 17      | 72    | 74    | 73   | 25.15 | -0.39 |
| 18      | 72    | 71    | 72   | 24.26 | +0.50 |
| 19      | 72    | 77    | 77   | 25.42 | -0.66 |
| 20      | 80    | 82    | 81   | 26.19 | -1.43 |
| 21      | 85    | 86    | 82   | 25.94 | -1.18 |
| 22      | 83    | 81    | 82   | 25.40 | -0.64 |
| 23      | 88    | 85    | 86   | 26.08 | -1.32 |
| 24      | 89    | 91    | 90   | 26.76 | -2.00 |
| 25      | 89    | 84    | 85   | 25.26 | -0.50 |
|         | 1577  | 1577  | Mean | 24.76 |       |

$\Sigma d = 3154$                        $\log = 49886$   
 $\log f = 89871$   
 $\log (Vs-Vo) = 1.39757$   
 $Vs-Vo = -24.98$                        $r = \pm 0.79$   
 $Vo = +0.33$   
 $Vd = -21.37$   
 $Vd = -0.16$                        $V = -3.18$

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$\beta$  GEMINORUM 1373.

SOLAR STANDARD 1462.

Observer } J. S. P.  
 Measurer }

| Region. | $d_1$ | $d_2$ | $d$       | $V$    | $v$   |
|---------|-------|-------|-----------|--------|-------|
| 1       | 049   | 047   | 048       | 23.91  | +0.27 |
| 2       | 44    | 51    | 48        | 23.24  | +0.94 |
| 3       | 50    | 51    | 50        | 23.55  | +0.63 |
| 4       | 50    | 45    | 48        | 22.10  | +2.08 |
| 5       | 53    | 51    | 52        | 23.39  | + .79 |
| 6       | 54    | 56    | 55        | 24.17  | + .01 |
| 7       | 60    | 59    | 60        | 25.76  | -1.58 |
| 8       | 56    | 58    | 57        | 23.88  | + .30 |
| 9       | 57    | 59    | 58        | 23.76  | + .42 |
| 10      | 59    | 60    | 60        | 24.01  | + .17 |
| 11      | 59    | 64    | 61        | 23.86  | + .32 |
| 12      | 61    | 66    | 63        | 24.10  | + .08 |
| 13      | 65    | 65    | 65        | 24.37  | - .19 |
| 14      | 66    | 68    | 67        | 24.58  | - .40 |
| 15      | 68    | 68    | 68        | 24.41  | - .23 |
| 16      | 60    | 64    | 62        | 21.77  | +2.41 |
| 17      | 70    | 75    | 72        | 24.80  | - .62 |
| 18      | 70    | 77    | 74        | 24.94  | - .76 |
| 19      | 74    | 72    | 73        | 24.10  | + .08 |
| 20      | 76    | 75    | 76        | 24.58  | - .40 |
| 21      | 82    | 74    | 78        | 24.67  | - .49 |
| 22      | 85    | 78    | 81        | 25.09  | - .91 |
| 23      | 85    | 78    | 82        | 24.87  | - .69 |
| 24      | 88    | 82    | 85        | 25.27  | -1.09 |
| 25      | 89    | 90    | 89        | 25.84  | -1.66 |
| 26      | 78    | 95    | 87        | 24.84  | - .66 |
|         | 1707  | 1728  | Mean..... | -24.18 | ..... |

$\Sigma d = 3435$

$\log = .53618$

$\log f = .84949$

$\log (Vs-Vo) = 1.38567$

$V_s - V_o = + 24.30$

$V_o = - 0.33$

$V_a = - 21.97$

$V_d = - 0.16$

$r = \pm 0.63$

$V = + 2.50$

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## 5 GEMINORUM 1373.

SOLAR STANDARD 1462.

High Power Objective.  
Low Power Ocular.Observer } J. S. P.  
Measurer }

| Region. | $d_1$ | $d_2$ | $d$     | $V$    | $v$   |
|---------|-------|-------|---------|--------|-------|
| 3       | 533   | 650   | 651     | 24 05  | +0 28 |
| 4       | 50    | 47    | 49      | 22 56  | +1 75 |
| 5       | 53    | 50    | 51      | 22 94  | +1 37 |
| 6       | 60    | 51    | 56      | 24 61  | -0 30 |
| 7       | 57    | 53    | 55      | 23 62  | +0 69 |
| 8       | 58    | 53    | 55      | 23 04  | +1 27 |
| 9       | 59    | 57    | 58      | 23 76  | +0 55 |
| 10      | 59    | 62    | 61      | 24 41  | -0 10 |
| 11      | 63    | 65    | 64      | 25 01  | -0 73 |
| 12      | 65    | 73    | 69      | 26 40  | -2 09 |
| 13      | 73    | 69    | 71      | 26 62  | -2 31 |
| 14      | 73    | 64    | 69      | 25 31  | -1 00 |
| 15      | 69    | 65    | 67      | 24 05  | +0 26 |
| 16      | 71    | 66    | 68      | 23 88  | +0 43 |
| 17      | 66    | 69    | 68      | 23 43  | +0 88 |
| 18      | 72    | 70    | 71      | 23 93  | +0 38 |
| 19      | 73    | 66    | 70      | 23 11  | +1 20 |
| 20      | 75    | 77    | 76      | 24 58  | -0 27 |
| 21      | 81    | 73    | 77      | 24 35  | +0 64 |
| 22      | 87    | 74    | 80      | 24 78  | -0 47 |
| 23      | 86    | 73    | 77      | 23 35  | +0 96 |
| 24      | 86    | 83    | 84      | 24 97  | -0 66 |
| 25      | 87    | 85    | 91      | 26 42  | -2 11 |
|         | 1575  | 1495  | Mean... | +24 31 | ..... |

 $\Sigma d = 3070$  $\log \dots = 48714$  $\log f = 89871$  $\log (Vs - Vo) = 1 38585$  $v = \pm 0 74$  $Vs - Vo = - 24 32$  $Vo = - 0 32$  $Va = 21 97$  $Vd = 0 15$  $V = 2 52$

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3 GEMINORUM 1373.

SOLAR STANDARD 1465.

Observer, J. S. P.  
Measurer, J. S. P.

| Region. | $d_1$ | $d_2$ | $d$   | $V$   | $v$   |
|---------|-------|-------|-------|-------|-------|
| 3       | 51    | 55    | 53    | 24.96 | 0.90  |
| 4       | 48    | 50    | 49    | 22.56 | +1.50 |
| 5       | 47    | 45    | 46    | 20.69 | -3.37 |
| 6       | 48    | 51    | 49    | 21.53 | +2.53 |
| 7       | 51    | 57    | 54    | 23.19 | +0.87 |
| 8       | 51    | 48    | 50    | 20.95 | +3.11 |
| 9       | 61    | 64    | 62    | 25.40 | 1.34  |
| 10      | 63    | 57    | 60    | 24.01 | 0.05  |
| 11      | 66    | 65    | 66    | 25.82 | -1.76 |
| 12      | 68    | 67    | 67    | 25.63 | 1.57  |
| 13      | 67    | 63    | 65    | 24.37 | 0.31  |
| 14      | 71    | 63    | 67    | 24.58 | 0.52  |
| 15      | 72    | 65    | 69    | 24.77 | 0.71  |
| 16      | 65    | 66    | 65    | 22.83 | +1.23 |
| 17      | 72    | 68    | 70    | 24.12 | 0.06  |
| 18      | 69    | 70    | 70    | 23.59 | +0.47 |
| 19      | 72    | 70    | 71    | 23.43 | +0.63 |
| 20      | 75    | 75    | 75    | 24.25 | 0.19  |
| 21      | 82    | 76    | 79    | 24.90 | 0.93  |
| 22      | 85    | 82    | 82    | 25.39 | -1.33 |
| 23      | 85    | 77    | 81    | 24.57 | 0.51  |
| 24      | 89    | 84    | 87    | 25.87 | 1.81  |
| 25      | 86    | 90    | 89    | 25.84 | 1.78  |
|         | 1544  | 1508  | Mean. | 24.06 | ..... |

$\Sigma d = 3052$

$\log = 48458$

$\log f = 89871$

$\log (V_s - V_o) = 1.38329$

$r = \pm 1.02$

$V_s - V_o = + 24.17$

$V_o = + 0.27$

$V_a = - 21.97$

$V_d = 0.16$

$V = 2.51$

$\beta$  GEMINORUM 1373.

SOLAR STANDARD 1468.

Observer J. S. P.  
Measurer f

| Region. | $d_1$ | $d_2$ | $d$        | $V$    | $v$   |
|---------|-------|-------|------------|--------|-------|
| 3       | 054   | 056   | 055        | 25.91  | -1.74 |
| 4       | 50    | 54    | 52         | 23.94  | +0.23 |
| 5       | 49    | 50    | 50         | 22.94  | +1.68 |
| 6       | 53    | 51    | 52         | 22.85  | +1.32 |
| 7       | 55    | 56    | 55         | 23.62  | +0.55 |
| 8       | 57    | 48    | 53         | 22.21  | +1.96 |
| 9       | 57    | 61    | 59         | 24.17  | 0.00  |
| 10      | 65    | 66    | 65         | 25.01  | -1.84 |
| 11      | 58    | 56    | 57         | 22.30  | +1.87 |
| 12      | 66    | 64    | 65         | 24.87  | -0.70 |
| 13      | 72    | 66    | 69         | 25.87  | -1.70 |
| 14      | 72    | 67    | 69         | 25.31  | -1.14 |
| 15      | 69    | 68    | 69         | 24.77  | -0.60 |
| 16      | 72    | 68    | 70         | 24.58  | 0.41  |
| 17      | 67    | 63    | 65         | 22.31  | +1.78 |
| 18      | 75    | 67    | 71         | 23.93  | +0.24 |
| 19      | 73    | 70    | 71         | 23.44  | +0.73 |
| 20      | 75    | 75    | 75         | 24.25  | -0.68 |
| 21      | 80    | 82    | 81         | 25.62  | -1.45 |
| 22      | 77    | 80    | 79         | 24.47  | -0.30 |
| 23      | 75    | 79    | 77         | 23.35  | +0.82 |
| 24      | 81    | 82    | 82         | 24.38  | -0.21 |
| 25      | 86    | 89    | 87         | 25.26  | -1.09 |
|         | 1538  | 1518  | Mean. .... | +24.17 | ..... |

$\Sigma d = 3056$                        $\log = .48515$   
 $\log f = .89871$   
 $\text{Log}(V_s - V_o) = 1.38386$                        $r = \pm 0.80$   
 $V_s - V_o = + 24.20$   
 $V_o = + 0.23$   
 $V_a = - 21.97$   
 $V_d = - 0.16$                        $V = + 2.30$

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$\beta$  GEMINORUM 1373.

SOLAR STANDARD 1517.

High Power.

Observer } J. S. P.  
 Measurer }

| Region. | $d_1$ | $d_2$ | $d$     | $V$    | $v$   |
|---------|-------|-------|---------|--------|-------|
| 4       | 047   | 046   | 046     | 21 18  | +2.79 |
| 5       | 45    | 50    | 48      | 21 59  | +2.28 |
| 6       | 52    | 53    | 52      | 22 85  | +1.12 |
| 7       | 55    | 56    | 55      | 23 62  | +0.35 |
| 8       | 52    | 51    | 52      | 21 79  | +2.18 |
| 9       | 59    | 60    | 59      | 24 17  | -0.20 |
| 10      | 61    | 66    | 64      | 25 61  | -1.64 |
| 11      | 62    | 62    | 62      | 24 25  | 0.28  |
| 12      | 61    | 63    | 62      | 23 72  | +0.25 |
| 13      | 63    | 66    | 64      | 24 00  | -0.03 |
| 14      | 70    | 66    | 68      | 24 94  | -0.97 |
| 15      | 66    | 70    | 68      | 24 41  | -0.44 |
| 16      | 68    | 68    | 68      | 23 88  | +0.09 |
| 17      | 72    | 68    | 70      | 24 12  | -0.15 |
| 18      | 71    | 73    | 72      | 24 26  | -0.29 |
| 19      | 73    | 71    | 72      | 23 77  | +0.20 |
| 20      | 72    | 75    | 77      | 24 90  | -0.93 |
| 21      | 77    | 85    | 81      | 25 62  | -1.65 |
| 22      | 80    | 82    | 81      | 25 09  | -1.12 |
| 23      | 78    | 84    | 81      | 24 57  | -0.60 |
| 24      | 81    | 80    | 81      | 24 08  | -0.11 |
| 25      | 87    | 86    | 86      | 24 97  | -1.00 |
|         | 1459  | 1481  | Mean... | +23 97 | ..... |

$\Sigma d = 2940$ 
 $\log = .46835$   
 $\log f = .91360$   
 $\log (V_s - V_o) = 1.38195$ 
 $r = \pm 0.79$   
 $V_s - V_o = + 24.10$   
 $V_o = + 0.54$   
 $V_a = - 21.97$   
 $V.d = - 0.16$ 
 $V = + 2.51$

## 3 GEMINORUM 1373.

SOLAR STANDARD 1519.

Observer (J. S. P.  
Measurer)

| Region. | $d_1$ | $d_2$ | $d$           | $V$   | $r$   |
|---------|-------|-------|---------------|-------|-------|
| 5       | 047   | 048   | 048           | 23.71 | +0.94 |
| 6       | 49    | 52    | 50            | 23.80 | -0.85 |
| 7       | 50    | 54    | 52            | 23.87 | -0.78 |
| 8       | 51    | 53    | 52            | 23.05 | -1.60 |
| 9       | 53    | 54    | 54            | 23.20 | +1.45 |
| 10      | 55    | 56    | 55            | 22.86 | +1.79 |
| 11      | 61    | 59    | 60            | 24.10 | -0.55 |
| 12      | 63    | 65    | 64            | 24.85 | -0.20 |
| 13      | 68    | 70    | 69            | 25.96 | -1.31 |
| 14      | 72    | 69    | 71            | 25.86 | -1.21 |
| 15      | 69    | 72    | 70            | 24.65 | 0.00  |
| 16      | 76    | 72    | 74            | 25.29 | -0.64 |
| 17      | 81    | 75    | 78            | 25.87 | -1.16 |
| 18      | 77    | 79    | 78            | 24.99 | -0.34 |
| 19      | 83    | 81    | 82            | 25.45 | -0.80 |
| 20      | 86    | 84    | 85            | 25.55 | -0.90 |
| 21      | 92    | 85    | 89            | 25.96 | -1.31 |
|         | 1133  | 1128  | Mean. . . . . | 24.65 |       |

$$\Sigma d = 2261$$

$$\log = .35430$$

$$\log j = 1.03958$$

$$\log (V_s - V_o) = 1.39388$$

$$r = \pm 0.72$$

$$V_s - V_o = + 24.77$$

$$V_o = + 0.41$$

$$V_a = - 21.97$$

$$V_d = - 0.16$$

$$V = + 3.05$$



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3 GEMINORUM 1373.

SOLAR STANDARD 1520.

Observer J. J. S. P.  
 Measurer J.

| Region. | $d_1$ | $d_2$ | $d$   | $V$   | $\rho$ |
|---------|-------|-------|-------|-------|--------|
| 5       | 046   | 048   | 047   | 23.22 | -1.70  |
| 6       | 53    | 51    | 52    | 24.75 | +0.17  |
| 7       | 50    | 51    | 51    | 23.41 | +1.61  |
| 8       | 59    | 57    | 58    | 25.71 | -0.79  |
| 9       | 57    | 60    | 58    | 24.92 | 0.00   |
| 10      | 59    | 55    | 57    | 23.69 | 1.23   |
| 11      | 64    | 64    | 64    | 25.71 | 0.79   |
| 12      | 68    | 68    | 68    | 26.41 | 1.48   |
| 13      | 72    | 70    | 71    | 26.71 | 1.79   |
| 14      | 67    | 72    | 70    | 25.49 | -0.57  |
| 15      | 68    | 72    | 70    | 24.65 | 0.27   |
| 16      | 73    | 69    | 71    | 24.27 | -0.65  |
| 17      | 73    | 73    | 73    | 24.17 | +0.75  |
| 18      | 73    | 81    | 80    | 25.63 | -0.71  |
| 19      | 83    | 81    | 82    | 25.45 | -0.53  |
| 20      | 79    | 83    | 81    | 24.35 | +0.57  |
| 21      | 88    | 84    | 86    | 25.09 | -0.17  |
|         | 1147  | 1139  | Mean. | 24.92 |        |

$$\begin{aligned} \Sigma d &= 2286 & \log &= 35908 \\ & & \log f &= 1.03958 \\ & & \log (V_S - V_\theta) &= 1.39866 \\ V_S - V_\theta &= + 25.04 & & \\ V_\theta &= + 0.38 & & \\ V_a &= - 21.97 & & \\ V_d &= - 0.16 & & \\ & & V &= - 3.29 \end{aligned}$$

$r = \pm 0.65$

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β GEMINORUM 1373

SOLAR STANDARD 1524.

Observer. † J. S. P.  
Measurer. †

| Region. | $d_1$ | $d_2$ | $d$     | $V$    | $t$   |
|---------|-------|-------|---------|--------|-------|
| 5       | 050   | 049   | 049     | 24.21  | +0.02 |
| 6       | 49    | 48    | 49      | 23.32  | +0.91 |
| 7       | 47    | 47    | 47      | 21.57  | +2.66 |
| 8       | 52    | 49    | 51      | 22.60  | +1.63 |
| 9       | 58    | 53    | 55      | 23.63  | +0.60 |
| 10      | 62    | 53    | 58      | 24.11  | +0.12 |
| 11      | 64    | 63    | 63      | 25.31  | -1.08 |
| 12      | 63    | 63    | 63      | 24.46  | -0.23 |
| 13      | 69    | 70    | 70      | 26.33  | -2.10 |
| 14      | 68    | 73    | 70      | 25.49  | -1.27 |
| 15      | 62    | 66    | 64      | 22.53  | +1.70 |
| 16      | 67    | 72    | 70      | 23.93  | +0.30 |
| 17      | 72    | 79    | 75      | 24.83  | +0.60 |
| 18      | 72    | 76    | 74      | 23.71  | -0.52 |
| 19      | 83    | 83    | 83      | 25.76  | -1.53 |
| 20      | 82    | 82    | 82      | 24.65  | -0.42 |
| 21      | 89    | 84    | 87      | 25.38  | -1.15 |
|         | 1109  | 1110  | Mean... | +24.23 | ..... |

$$\begin{aligned} \Sigma d &= 2219 & \log &= -34616 \\ & & \log f &= 1.03958 \\ V_s - V_o &= -24.31 & \log (V_s - V_o) &= 1.38574 & r &= \pm 0.84 \\ V_o &= -0.23 \\ V_m &= -21.97 \\ V_d &= -0.16 & V &= -2.41 \end{aligned}$$

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$\beta$  GEMINORUM 1306.

Observer, (J. S. P.  
 Measurer, (

| Region. | $d_1$ | $d_2$ | $d$       | $V$   | $v$   |
|---------|-------|-------|-----------|-------|-------|
| 3       | 023   | 020   | 021       | 9.89  | +0.47 |
| 4       | 22    | 22    | 22        | 10.13 | +0.23 |
| 5       | 19    | 18    | 19        | 8.55  | +1.53 |
| 6       | 24    | 21    | 23        | 10.11 | +0.25 |
| 7       | 28    | 25    | 26        | 11.16 | -0.80 |
| 8       | 25    | 23    | 24        | 10.06 | +0.30 |
| 9       | 28    | 28    | 27        | 11.06 | -0.70 |
| 10      | 22    | 24    | 23        | 9.20  | +1.16 |
| 11      | 32    | 26    | 29        | 11.34 | -0.98 |
| 12      | 28    | 24    | 26        | 9.95  | +0.41 |
| 13      | 30    | 21    | 26        | 9.75  | +0.61 |
| 14      | 26    | 30    | 28        | 10.27 | -0.09 |
| 15      | 30    | 38    | 34        | 12.21 | -1.85 |
| 16      | 26    | 26    | 26        | 9.13  | +1.23 |
| 17      | 29    | 36    | 32        | 11.02 | -0.66 |
| 18      | 27    | 25    | 26        | 8.76  | +1.60 |
| 19      | 36    | 24    | 30        | 9.90  | +0.46 |
| 20      | 38    | 31    | 35        | 11.32 | -0.96 |
| 21      | 37    | 28    | 32        | 10.12 | +0.24 |
| 22      | 35    | 32    | 34        | 10.53 | -0.17 |
| 23      | 41    | 35    | 38        | 11.53 | -1.17 |
| 24      | 40    | 37    | 39        | 11.59 | -1.23 |
| 25      | 38    | 36    | 37        | 10.74 | -0.38 |
|         | 683   | 630   | Mean..... | 10.36 | ..... |

$\Sigma d = 1313$

$V_s - V_o = + 10.40$   
 $V_o = + 0.33$   
 $V_a = - 8.67$   
 $V_d = - 0.22$

$\log = .11826$   
 $\log f = .89871$   
 $\log (V_s - V_o) = 1.01697$

$v = \pm 0.63$

$V = + 1.84$

♄ GEMINORUM 1417.

Observer J. S. P.  
 Measurer J. S. P.

| Region. | $d_1$ | $d_2$ | $d$   | $V$   | $\rho$ |
|---------|-------|-------|-------|-------|--------|
| 3       | 961   | 958   | 959   | 27.79 | -0.80  |
| 4       | 65    | 65    | 65    | 29.93 | -1.34  |
| 5       | 59    | 58    | 59    | 26.54 | +2.05  |
| 6       | 66    | 64    | 65    | 28.56 | -0.03  |
| 7       | 67    | 65    | 66    | 28.34 | -0.25  |
| 8       | 65    | 64    | 65    | 27.24 | -1.35  |
| 9       | 74    | 69    | 71    | 29.08 | 0.49   |
| 10      | 73    | 77    | 75    | 30.01 | -1.42  |
| 11      | 75    | 76    | 76    | 29.73 | -1.14  |
| 12      | 77    | 76    | 76    | 29.08 | -0.49  |
| 13      | 78    | 75    | 77    | 28.87 | 0.28   |
| 14      | 82    | 74    | 78    | 28.61 | -0.02  |
| 15      | 78    | 79    | 78    | 28.00 | +0.59  |
| 16      | 80    | 76    | 78    | 27.39 | +1.20  |
| 17      | 79    | 77    | 78    | 26.87 | +1.72  |
| 18      | 83    | 84    | 84    | 28.31 | +0.28  |
| 19      | 85    | 85    | 85    | 28.06 | +0.53  |
| 20      | 91    | 87    | 89    | 28.78 | -0.19  |
| 21      | 96    | 96    | 96    | 30.36 | 1.77   |
| 22      | 96    | 96    | 96    | 29.73 | -1.14  |
| 23      | 92    | 94    | 93    | 28.21 | +0.38  |
| 24      | 94    | 100   | 97    | 28.84 | -0.25  |
| 25      | 105   | 98    | 101   | 29.32 | -0.73  |
| 1821    | 1793  | Mean  | 28.59 |       |        |

$\Sigma d = 3615$                        $\log = 55811$   
     $\log f = 89871$   
     $\log (Vs V_o) = 145682$                        $\rho = \pm 0.68$

$V_s - V_o = + 28.63$   
 $V_o = + 0.33$   
 $V_s = - 27.36$   
 $V_d = - 0.19$                        $V = - 1.41$

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3 GEMINORUM 1424.

Observer J. S. P.  
 Measurer

| Region. | $d_1$ | $d_2$ | $d$  | $V$   | $v$   |
|---------|-------|-------|------|-------|-------|
| 3       | 063   | 060   | 062  | 29 21 | 0 07  |
| 4       | 61    | 61    | 61   | 28 08 | 1 06  |
| 5       | 62    | 63    | 62   | 27 89 | 1 25  |
| 6       | 66    | 63    | 65   | 28 56 | 0 58  |
| 7       | 65    | 66    | 65   | 27 91 | 1 23  |
| 8       | 62    | 60    | 61   | 25 56 | 3 58  |
| 9       | 68    | 71    | 69   | 28 26 | +1 88 |
| 10      | 72    | 74    | 73   | 29 21 | 0 07  |
| 11      | 74    | 70    | 72   | 28 17 | +0 97 |
| 12      | 70    | 82    | 76   | 29 08 | 0 06  |
| 13      | 73    | 82    | 78   | 29 25 | 0 11  |
| 14      | 78    | 83    | 80   | 29 34 | 0 20  |
| 15      | 77    | 83    | 80   | 28 72 | -0 42 |
| 16      | 83    | 85    | 84   | 29 50 | 0 36  |
| 17      | 89    | 91    | 90   | 31 00 | 1 86  |
| 18      | 94    | 93    | 93   | 31 34 | 2 20  |
| 19      | 87    | 93    | 90   | 29 70 | 0 56  |
| 20      | 92    | 96    | 94   | 30 40 | 1 26  |
| 21      | 90    | 94    | 92   | 29 10 | 0 04  |
| 22      | 97    | 98    | 98   | 30 35 | -1 21 |
| 23      | 90    | 96    | 93   | 28 21 | +0 93 |
| 24      | 101   | 107   | 104  | 30 92 | -1 78 |
| 25      | 106   | 103   | 105  | 30 48 | -1 34 |
|         | 1826  | 1874  | Mean | 29 14 | ..... |

$\Sigma d = 3694$

$\log = 56750$

$\log f = 89871$

$\log (Vs-Vo) = 1 46621$

$c = \pm 0 88$

$Vs-Vo = 29 26$

$Vo = + 0 33$

$Va = - 27 89$

$Vd = - 0 12$

$V = - 1 58$

## 3 GEMINORUM 1443.

Observer } J. S. P.  
Measurer }

| Region. | $d_1$ | $d_2$ | $d$       | $\Gamma$ | $r$   |
|---------|-------|-------|-----------|----------|-------|
| 3       | 061   | 060   | 061       | 28.76    | +2.80 |
| 4       | 66    | 67    | 66        | 30.39    | -1.17 |
| 5       | 66    | 65    | 66        | 29.69    | +1.87 |
| 6       | 66    | 67    | 66        | 29.00    | +2.56 |
| 7       | 68    | 75    | 72        | 30.92    | -0.64 |
| 8       | 74    | 78    | 76        | 31.84    | -0.28 |
| 9       | 80    | 77    | 78        | 31.95    | -0.39 |
| 10      | 78    | 80    | 79        | 31.62    | -0.06 |
| 11      | 79    | 83    | 81        | 31.69    | -0.13 |
| 12      | 86    | 87    | 87        | 33.29    | -1.73 |
| 13      | 87    | 82    | 84        | 31.50    | +0.06 |
| 14      | 86    | 86    | 86        | 32.64    | -1.08 |
| 15      | 85    | 88    | 87        | 31.23    | +0.33 |
| 16      | 92    | 83    | 88        | 30.91    | +0.65 |
| 17      | 93    | 94    | 93        | 32.05    | -0.49 |
| 18      | 95    | 95    | 95        | 32.01    | -0.45 |
| 19      | 92    | 94    | 93        | 30.70    | -0.86 |
| 20      | 100   | 99    | 100       | 32.34    | -0.78 |
| 21      | 104   | 96    | 100       | 31.63    | -0.07 |
| 22      | 107   | 103   | 105       | 32.52    | -0.96 |
| 23      | 108   | 106   | 107       | 32.45    | -0.89 |
| 24      | 114   | 108   | 111       | 33.00    | -1.44 |
| 25      | 118   | 114   | 116       | 33.67    | -2.11 |
|         | 2005  | 1987  | Mean..... | 31.56    |       |

$$\begin{aligned} \Sigma d &= 3992 & \log &= .60119 \\ & & \log \bar{r} &= .89871 \\ V_s - V_o &= -31.62 & \log(V_s - V_o) &= .49990 \\ V_o &= +0.33 & & \\ V_a &= -28.83 & & \\ V_d &= -0.09 & V &= +3.03 \end{aligned} \quad r = .84$$

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$\beta$  GEMINORUM 1452.

Observer J. S. P.  
Measurer J.

| Region. | $d_1$ | $d_2$ | $d$       | $V$    | $e$   |
|---------|-------|-------|-----------|--------|-------|
| 3       | 065   | 062   | 063       | 29 21  | +1 43 |
| 4       | 65    | 62    | 64        | 29 17  | +1 17 |
| 5       | 66    | 65    | 65        | 29 24  | +1 40 |
| 6       | 65    | 72    | 69        | 30 32  | +0 32 |
| 7       | 74    | 68    | 71        | 30 49  | +0 15 |
| 8       | 73    | 69    | 71        | 29 75  | +0 89 |
| 9       | 70    | 78    | 74        | 30 31  | +0 33 |
| 10      | 80    | 76    | 78        | 31 22  | -0 58 |
| 11      | 79    | 72    | 76        | 29 73  | +0 91 |
| 12      | 84    | 79    | 81        | 30 99  | -0 35 |
| 13      | 88    | 87    | 88        | 33 37  | -2 73 |
| 14      | 85    | 79    | 82        | 30 08  | +0 56 |
| 15      | 88    | 95    | 91        | 32 67  | -2 03 |
| 16      | 88    | 92    | 90        | 31 61  | -0 97 |
| 17      | 93    | 87    | 90        | 31 00  | -0 36 |
| 18      | 89    | 94    | 92        | 31 00  | -0 36 |
| 19      | 93    | 89    | 91        | 30 04  | +0 60 |
| 20      | 87    | 89    | 88        | 28 78  | +1 88 |
| 21      | 98    | 98    | 98        | 31 00  | -0 36 |
| 22      | 99    | 97    | 98        | 30 35  | +0 29 |
| 23      | 99    | 105   | 102       | 30 94  | -0 30 |
| 24      | 105   | 106   | 105       | 31 22  | -0 58 |
| 25      | 108   | 111   | 110       | 31 93  | -1 29 |
|         | 1941  | 1932  | Mean..... | -30 64 | ..... |

$\Sigma d = 3873$

$\log = .58805$

$\log f = .89871$

$\log (Vs-Vo) = 1.48676$

$r = \pm 0.74$

$Vs-Vo = + 30 67$

$Vo = + 0 33$

$Va = - 29 19$

$Vd = - 0 11$

$V = + 1 70$

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3 GEMINORUM 1460.

Observer } J. S. P.  
Measurer }

| Region. | $d_1$ | $d_2$ | $d$  | $V$   | $e$   |
|---------|-------|-------|------|-------|-------|
| 3       | 65    | 64    | 64   | 30 15 | -1 91 |
| 4       | 68    | 63    | 66   | 30 39 | +1 67 |
| 5       | 66    | 70    | 68   | 30 59 | -1 47 |
| 6       | 66    | 66    | 66   | 29 00 | +3 06 |
| 7       | 68    | 70    | 69   | 29 63 | -2 43 |
| 8       | 70    | 71    | 71   | 29 75 | +2 31 |
| 9       | 76    | 80    | 78   | 31 95 | -0 11 |
| 10      | 83    | 82    | 82   | 32 82 | -0 76 |
| 11      | 85    | 83    | 84   | 32 86 | -0 80 |
| 12      | 86    | 82    | 84   | 32 14 | -0 08 |
| 13      | 90    | 83    | 87   | 32 62 | -0 56 |
| 14      | 93    | 89    | 91   | 33 38 | 1 32  |
| 15      | 94    | 88    | 92   | 33 63 | -0 97 |
| 16      | 93    | 89    | 91   | 31 96 | -0 10 |
| 17      | 101   | 97    | 99   | 34 11 | -2 05 |
| 18      | 92    | 92    | 92   | 31 00 | -1 06 |
| 19      | 95    | 100   | 98   | 32 35 | -0 29 |
| 20      | 102   | 105   | 103  | 33 31 | -1 25 |
| 21      | 102   | 105   | 104  | 32 90 | -0 84 |
| 22      | 102   | 108   | 105  | 32 52 | -0 46 |
| 23      | 107   | 104   | 105  | 31 85 | +0 21 |
| 24      | 117   | 119   | 118  | 35 08 | -3 02 |
| 25      | 113   | 121   | 117  | 33 96 | -1 90 |
|         | 2034  | 2031  | Mean | 32 06 |       |

$$\begin{aligned} \sum d &= 4065 & \log \bar{d} &= 60906 \\ & & \log \bar{V} &= 89871 \\ V_s - V_o &= 32 49 & \log (V_s - V_o) &= 50777 \\ V_o &= 0 33 & & \\ V_a &= 29 24 & & \\ V_d &= 0 09 & V &= 3 19 \end{aligned} \quad e = \pm 1 14$$



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4 GEMINORUM 1472.

SOLAR STANDARD 1520.

Observer U. J. S. P.  
Measurer I

| Region. | $d_1$ | $d_2$ | $d_3$   | $V$         | $v$   |
|---------|-------|-------|---------|-------------|-------|
| 5       | 653   | 656   | 655     | 27 17       | +3 94 |
| 6       | 61    | 63    | 62      | 29 51       | +1 60 |
| 7       | 71    | 69    | 70      | 32 14       | -1 03 |
| 8       | 67    | 67    | 67      | 29 69       | +1 42 |
| 9       | 70    | 73    | 71      | 30 51       | +0 60 |
| 10      | 73    | 73    | 73      | 30 35       | -0 76 |
| 11      | 76    | 77    | 77      | 30 93       | 0 18  |
| 12      | 77    | 80    | 78      | 30 29       | -0 82 |
| 13      | 83    | 86    | 85      | 31 98       | 0 87  |
| 14      | 89    | 87    | 88      | 32 41       | 1 30  |
| 15      | 88    | 92    | 90      | 31 69       | 0 58  |
| 16      | 95    | 93    | 94      | 32 13       | 1 02  |
| 17      | 96    | 97    | 96      | 31 81       | 0 70  |
| 18      | 100   | 103   | 102     | 32 68       | 1 57  |
| 19      | 104   | 102   | 103     | 31 97       | -0 86 |
| 20      | 104   | 103   | 104     | 31 26       | -0 15 |
| 21      | 115   | 108   | 111     | 32 38       | 1 27  |
|         | 1422  | 1429  | Mean... | ... + 31 11 | ...   |

$$\begin{aligned} \Sigma d &= 2851 & \log &= 45500 \\ & & \log f &= 1 03958 \\ V_s - V_o &= + 31 23 & \log (V_s - V_o) &= 1 49458 \\ V_o &= + 0 38 & & \\ V_a &= + 29 41 & & \\ V_d &= - 0 21 & V &= + 1 99 \end{aligned} \quad r = \pm 0 94$$

3 GEMINORUM 1500.

SOLAR STANDARD 1519.

Observer } J. S. P.  
 Measurer }

| Region. | $d_1$ | $d_2$ | $d$       | $V$   | $v$   |
|---------|-------|-------|-----------|-------|-------|
| 5       | 061   | 064   | 062       | 30.63 | -0.20 |
| 6       | 66    | 66    | 66        | 31.42 | -0.59 |
| 7       | 64    | 64    | 64        | 29.38 | +1.45 |
| 8       | 61    | 66    | 64        | 28.36 | +2.47 |
| 9       | 73    | 69    | 71        | 30.51 | +0.32 |
| 10      | 69    | 70    | 70        | 29.10 | +1.73 |
| 11      | 77    | 78    | 77        | 30.93 | -0.10 |
| 12      | 79    | 77    | 78        | 30.29 | +0.54 |
| 13      | 86    | 78    | 82        | 30.85 | -0.02 |
| 14      | 91    | 89    | 90        | 32.77 | -1.94 |
| 15      | 87    | 80    | 84        | 29.58 | +1.25 |
| 16      | 92    | 88    | 90        | 30.76 | +0.07 |
| 17      | 100   | 92    | 96        | 31.79 | -0.96 |
| 18      | 98    | 102   | 100       | 32.04 | -1.21 |
| 19      | 104   | 106   | 105       | 32.59 | -1.76 |
| 20      | 106   | 103   | 105       | 31.56 | -0.73 |
| 21      | 112   | 104   | 108       | 31.50 | -0.67 |
|         | 1426  | 1396  | Mean..... | 30.83 | ..... |

$\Sigma d = 2822$

$\log = .45056$

$\log f = 1.03958$

$\log (V_s - V_o) = 1.49014$

$r = \pm 0.81$

$V_s - V_o = + 30.91$

$V_o = + 0.41$

$V_a = - 29.14$

$V_d = - 0.15$

$V = + 2.03$

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$\beta$  GEMINORUM 1502

Observer } J. S. P.  
 Measurer }

| Region. | $d_1$ | $d_2$ | $d$           | $V$    | $v$   |
|---------|-------|-------|---------------|--------|-------|
| 3       | 059   | 065   | 062           | 29.21  | +1.98 |
| 4       | 69    | 62    | 65            | 29.93  | +1.26 |
| 5       | 65    | 65    | 65            | 29.24  | +1.95 |
| 6       | 64    | 70    | 67            | 29.44  | +1.75 |
| 7       | 67    | 68    | 68            | 29.20  | +1.99 |
| 8       | 73    | 71    | 72            | 30.17  | +1.02 |
| 9       | 82    | 76    | 79            | 32.36  | -1.17 |
| 10      | 83    | 81    | 82            | 32.82  | -1.63 |
| 11      | 79    | 80    | 80            | 31.30  | -0.13 |
| 12      | 85    | 90    | 87            | 33.29  | 2.10  |
| 13      | 89    | 87    | 88            | 33.00  | -1.81 |
| 14      | 86    | 86    | 83            | 30.44  | +0.75 |
| 15      | 88    | 88    | 88            | 31.59  | -0.40 |
| 16      | 90    | 85    | 88            | 30.91  | -0.28 |
| 17      | 89    | 91    | 90            | 31.02  | -0.17 |
| 18      | 89    | 91    | 90            | 30.33  | -0.86 |
| 19      | 99    | 100   | 99            | 32.68  | -1.49 |
| 20      | 100   | 100   | 100           | 32.34  | -1.15 |
| 21      | 98    | 100   | 99            | 31.31  | -0.12 |
| 22      | 108   | 102   | 105           | 32.32  | -1.13 |
| 23      | 101   | 93    | 97            | 29.42  | -1.77 |
| 24      | 108   | 114   | 111           | 33.00  | -1.81 |
| 25      | 110   | 113   | 111           | 32.22  | -1.03 |
|         | 1975  | 1978  | Mean. . . . . | +31.19 |       |

$$\begin{aligned} \Sigma d &= 3953 & \log &= .59693 \\ & & \log f &= .89871 \\ V_s - V_o &= + 31.31 & \log (V_s - V_o) &= 1.49564 \\ V_o &= + 0.33 & & \\ V_a &= - 29.09 & & \\ V_d &= - 0.12 & V &= + 2.43 \end{aligned} \quad r = \pm 0.93$$

β GEMINORUM 1527.

SOLAR STANDARD 1520.

Observer J. S. P.  
Measurer J.

| Region. | $d_1$ | $d_2$ | $d$            | $V$    | $r$   |
|---------|-------|-------|----------------|--------|-------|
| 5       | 047   | 053   | 050            | 24.70  | -2.16 |
| 6       | 51    | 52    | 52             | 24.75  | +2.11 |
| 7       | 55    | 58    | 56             | 25.71  | +1.15 |
| 8       | 62    | 61    | 62             | 27.48  | -0.62 |
| 9       | 58    | 64    | 61             | 26.21  | -0.65 |
| 10      | 60    | 64    | 62             | 25.77  | -1.09 |
| 11      | 69    | 65    | 67             | 26.91  | -0.05 |
| 12      | 66    | 72    | 69             | 26.79  | -0.07 |
| 13      | 74    | 73    | 73             | 27.46  | -0.60 |
| 14      | 75    | 79    | 77             | 28.04  | -1.18 |
| 15      | 83    | 74    | 79             | 27.82  | -0.96 |
| 16      | 85    | 82    | 83             | 28.37  | -1.51 |
| 17      | 86    | 82    | 84             | 27.81  | -0.95 |
| 18      | 87    | 79    | 83             | 26.59  | -0.27 |
| 19      | 93    | 90    | 91             | 28.25  | -1.39 |
| 20      | 90    | 90    | 90             | 27.05  | 0.19  |
|         | 1141  | 1138  | Mean . . . . . | +26.86 | ..... |

$\Sigma d = 2279$

$\log = .35774$

$\log f = 1.07349$

$\log (V_s - V_o) = 1.43123$

$r = \pm 0.77$

$V_s - V_o = -26.99$

$V_o = -0.38$

$V_a = -24.85$

$V_d = -0.24$

$V = -2.37$

SUMMARY OF COMPARATOR MEASURES OF β GEMINORUM 1373.

| Solar Standard. | No. of Regions. | Velocity. | Residual O - C. | Probable error of Single Region. |
|-----------------|-----------------|-----------|-----------------|----------------------------------|
| 1360 .....      | 25              | +2.93     | -0.21           | ±1.10                            |
| 1461 .....      | 25              | -3.02     | -0.31           | 0.71                             |
| 1461 .....      | 23              | +2.23     | +0.49           | 0.81                             |
| 1462 .....      | 22              | +2.85     | -0.13           | 0.81                             |
| 1462 .....      | 25              | +3.03     | -0.31           | 0.77                             |
| 1462 .....      | 23              | +3.18     | -0.46           | 0.79                             |
| 1462 .....      | 26              | +2.50     | +0.22           | 0.63                             |
| 1462 .....      | 23              | +2.52     | +0.20           | 0.74                             |
| 1465 .....      | 23              | +2.31     | +0.41           | 1.02                             |
| 1468 .....      | 23              | +2.30     | +0.42           | 0.80                             |
| 1517 .....      | 22              | -2.51     | +0.21           | 0.79                             |
| 1519 .....      | 17              | -3.05     | -0.33           | 0.72                             |
| 1520 .....      | 17              | -3.29     | -0.57           | 0.65                             |
| 1524 .....      | 17              | +2.41     | +0.31           | 0.84                             |

Mean velocity + 2.72.

Mean P. E. ± 0.80.

Probable error of single measure = ± 0.24km.

Probable error of mean velocity = ± 0.065km.

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SUMMARY OF MEASURES OF 11 PLATES OF  $\beta$  GEMINORUM.

| Plate No. | No. of Regions. | Velocity. | Residual. | Probable error of Single Region. |
|-----------|-----------------|-----------|-----------|----------------------------------|
| 1306..... | 23              | +1.84     | +0.37     | $\pm 0.63$                       |
| 1373..... |                 | 2.72      | -0.51     | 0.80                             |
| 1417..... | 23              | 1.41      | +0.80     | 0.68                             |
| 1424..... | 23              | 1.58      | +0.63     | 0.88                             |
| 1443..... | 23              | 3.03      | -0.82     | 0.84                             |
| 1452..... | 23              | 1.70      | +0.51     | 0.74                             |
| 1460..... | 23              | 3.19      | -0.98     | 1.14                             |
| 1472..... | 17              | 1.99      | +0.22     | 0.94                             |
| 1500..... | 17              | 2.03      | +0.18     | 0.81                             |
| 1502..... | 23              | 2.43      | -0.22     | 0.93                             |
| 1527..... | 16              | 2.37      | -0.16     | 0.77                             |

Mean velocity + 2.21.      Mean P. E.  $\pm 0.83$ .Probable error of plate =  $\pm 0.40$ .Probable error of mean =  $\pm 0.12$ .

As the summaries and probable errors above show, the error of setting on a single region is on the average in the several measures of the plate No. 1373  $\pm 0.80$ km., and only slightly greater  $\pm 0.83$  for the other plates. Hartmann obtained a probable error of  $\pm 0.67$ km., somewhat smaller than above. The difference may be due partly to his greater skill and experience in measurement and partly possibly to better quality of spectra. If a better spectrum than 1373 had been selected and it were measured with the best of the fundamental spectra, I have no doubt the probable error would be considerably diminished.

The measures of the 11 plates of  $\beta$  Geminorum give an indication of the systematic discrepancies to be expected in the production of the spectra, although some allowance should be made for accidental errors of measurement. A total range of nearly 1.8km. is shown and the probable error of a plate is  $\pm 0.40$ km. These plates were made under average conditions, no special care being taken, and the plates are of average quality only. A systematic difference between these measures and other determinations by the old method of measurement at this, and other observatories of slightly over a kilometre +3.5km. with micrometer microscope, +2.2km. with comparator is present. These plates have only been measured by the comparator, and hence it cannot be determined yet whether this difference is in the plates or in the method of measurement, but the latter seems the more probable. It is interesting to note in this connection that there is a gradual and systematic increase in the velocity of the different regions from the red to the violet in all the star plates measured, but no explanation of the cause of this discrepancy can be offered. It is unquestionable that if this were removed the probable error of a single region would be materially reduced. Finally, it is probable that, as more experience is gained with the instrument, the accuracy of the measures will be considerably increased.

## THE COELOSTAT TELESCOPE.

Although the optical and mechanical parts of this instrument have been ready for nearly two years, the shelter and connecting passage and tunnel were not finally completed until about July, 1908, and it was not possible to make any use of the installation until some time after that date. The spectrograph, which is described by Dr. DeLury in Appendix C, was erected and adjusted as soon after as possible, but owing to the inferior quality of the grating, the work has been much handicapped.

The telescope itself performs admirably and as it has not yet been described, it seems desirable to mention here its principal features.

Essentially the optical parts of the installation consist of the coelostat mirror, which reflects the sun's light in a southerly direction to a secondary plane mirror, which in turn reflects the beam north to a concave mirror forming a solar image 80 feet south in the basement of the observatory building.

A general view of the coelostat and secondary mirror, and of the shelters and connecting passages for the beam is given in Fig. 13. The coelostat and secondary mirror are covered by a house on wheels, which can be easily rolled back (and is thus shown in the figure) by a convenient mechanism over the louvred passageway which contains the concave mirror. Between the latter and the basement of the Observatory is another ventilated passage and a tunnel. The house and passages are constructed of wood, covered with galvanized iron painted white, and all very thoroughly ventilated by galvanized iron louvres to prevent as far as possible temperature stratification or disturbance in the course of the beam. It would have been preferable to continue the ventilated passage along the whole course of the beam from the coelostat to the Observatory wall, but this was not possible on account of the necessity of a driveway. This difficulty was overcome by making a tunnel for the last 20 feet, or so, through which the beam passes to the focus. As the latter is usually five feet or so outside the wall, this leaves an unventilated distance of about 15 feet, which apparently has no very serious effect on the definition.

A general view of the telescope looking north is given in Fig. 14, and another view looking south towards the Observatory in Fig. 15. The coelostat has a plane mirror 20 inches in diameter which rotates on an axis, in or parallel to its plane, which is parallel to the axis of the earth and driven by clockwork at half the diurnal rate. The whole instrument is moved bodily east and west by the sheave and cable, shown in the figures, on cast-iron ways resting on a cement pier. The purpose of this movement is to enable the coelostat mirror to receive the sun light more nearly normally by placing it towards the west in the morning and the east in the afternoon. The ways are long enough to permit of sufficient movement to prevent any interception of the return beam from the concave, which passes under the secondary mirror.

The beam of sunlight from the coelostat mirror is reflected in a constant direction so long as the declination remains the same, but evidently any change in the declination of the incident light entails a similar change in the direction of the reflected light, and it is necessary to have a movable secondary mirror to receive this beam and direct it towards the image forming concave. This change of direction of the reflected beam, due to the change of declination of the sun, is provided for by attaching the mirror to a carriage rolling on ways in a north and south direction, the mechanism for changing the position of the secondary being identical with that used for moving the coelostat and the concave mirror, and being well shown in the figures. During the winter when the sun is low in the sky, the secondary has to be brought close to the coelostat, and in the summer away from it. The secondary mirror, also of 20 inches diameter, can be quickly adjusted in inclination by quick and slow motions so as to send the beam directly to the concave mirror.

The latter of 18 inches diameter and 80 feet focus is movable in the north and south direction over ways about 20 feet long, in order to be able to vary the position of the image for different purposes. It is also adjustable vertically and has slow motions provided for moving around a vertical and horizontal axis in order to place any desired part of the image, say, on the slit of the spectroscope or in any other required position. The beam of light from this mirror passes directly under the secondary mirror through the opening in its support, and is inclined downward  $3\frac{1}{2}^\circ$ , the same inclination being given to the ways on which the concave mirror carriage moves. This inclination was adopted in order to enable the coelostat to be raised a little above

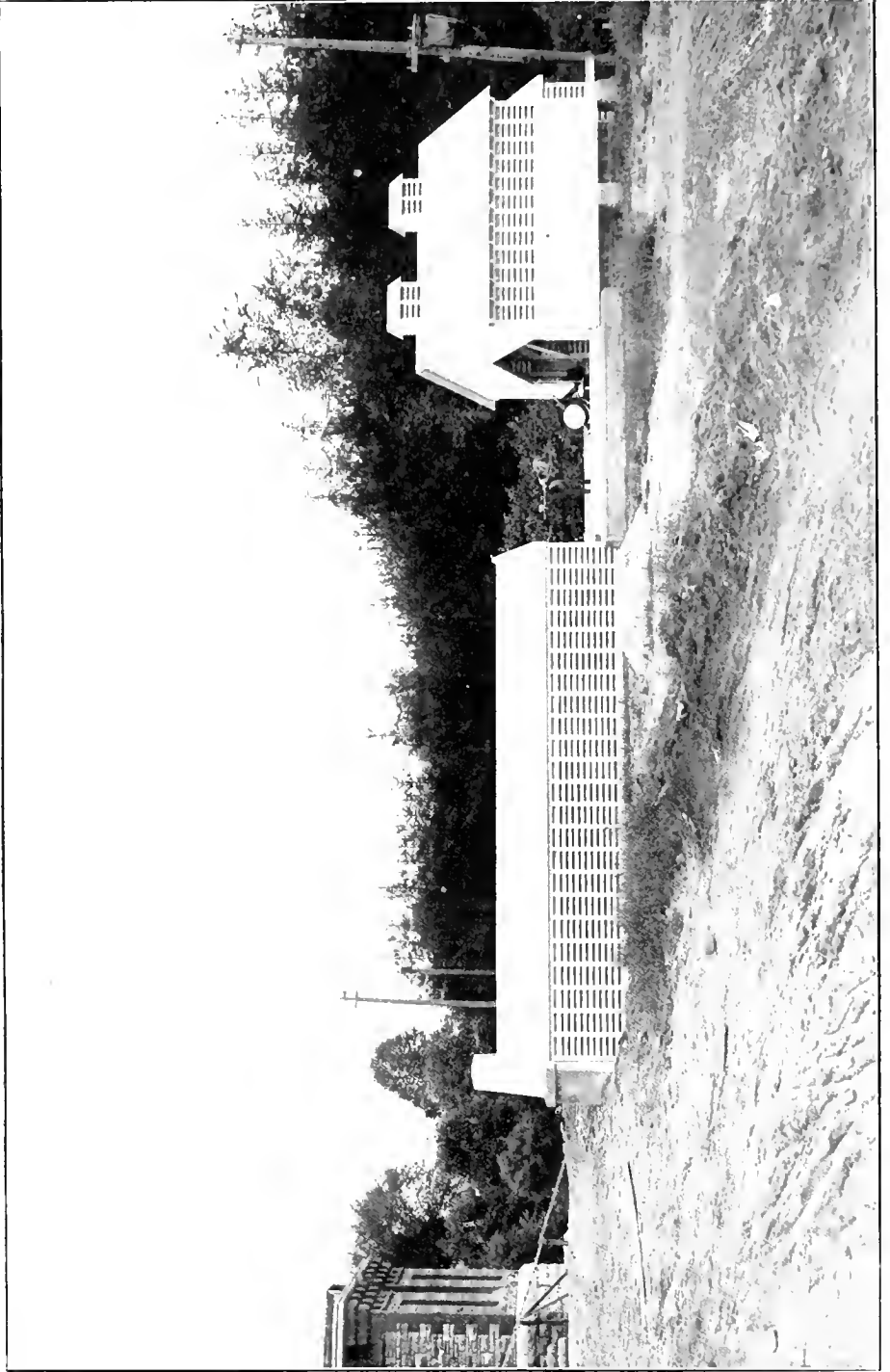


FIG. 13—Celostat House.





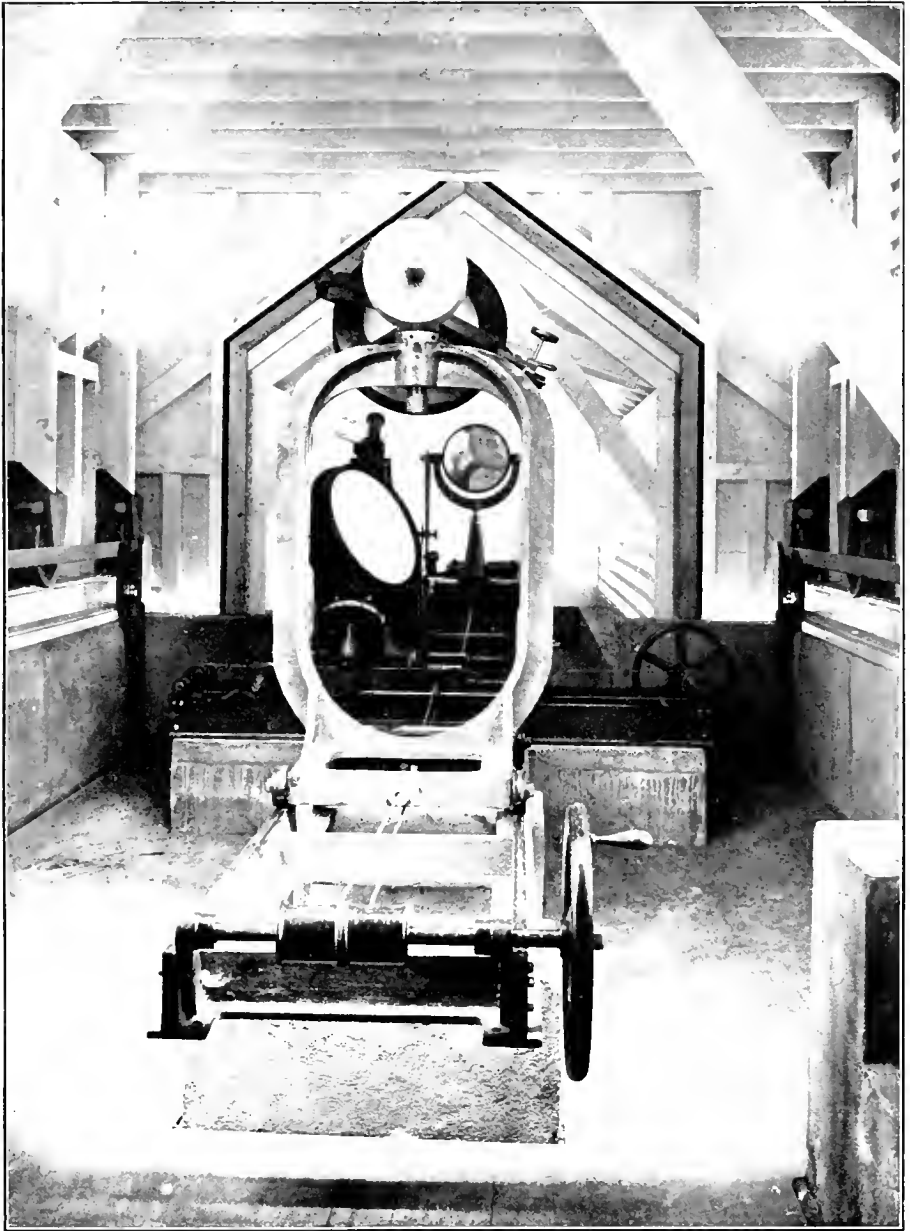


FIG. 14—Colostat Telescope Mechanism, looking north.



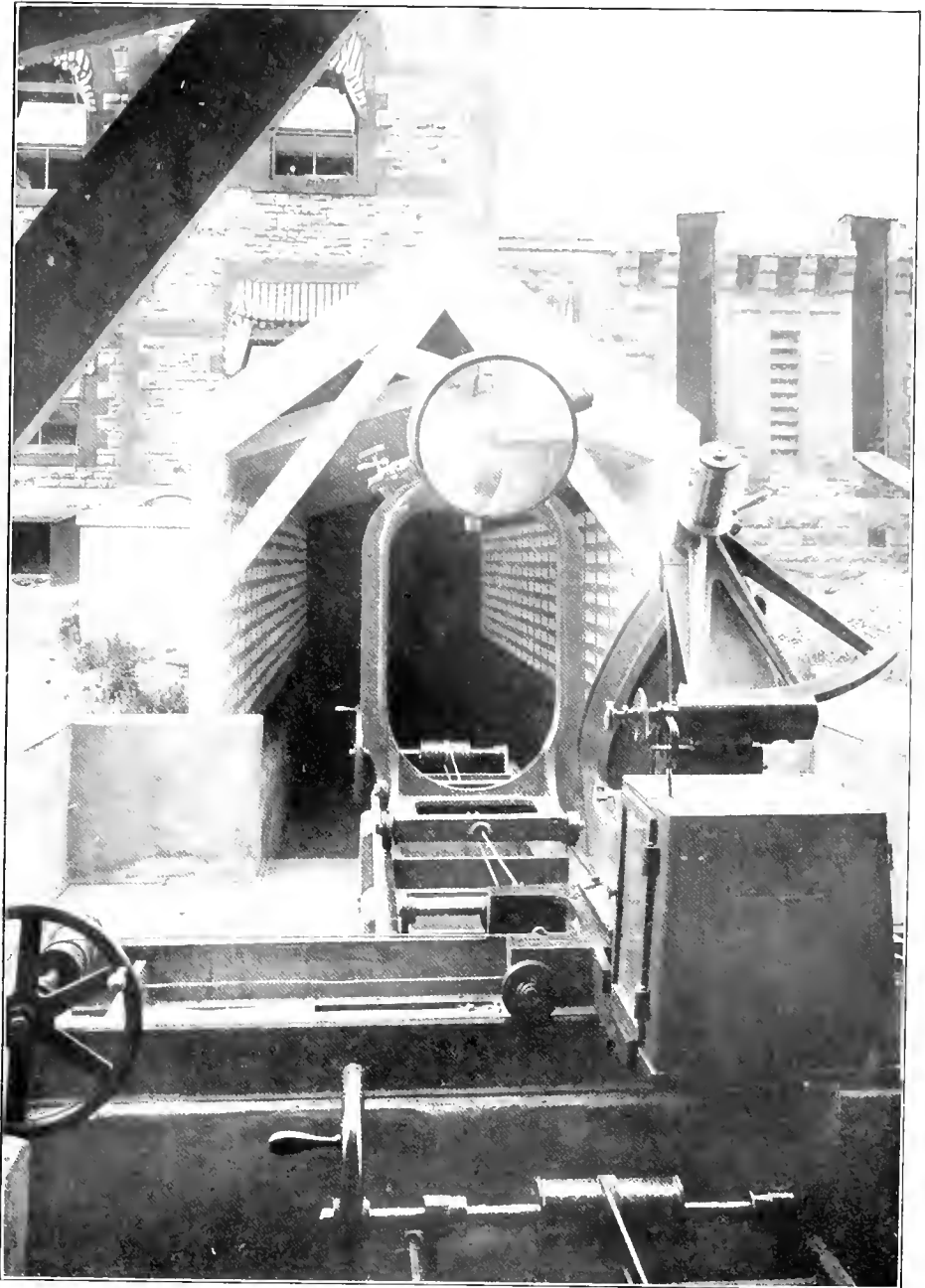


FIG. 15 - Colostat Telescope Mechanism, looking south.



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the surface of the ground, and to keep the beam some distance away from the roof of the tunnel.

The coelostat was made by the J. A. Brashear Co., in 1905, for eclipse purposes, and the secondary and concave mirrors in 1907. The designs and drawings for the remainder of the mechanical parts were made by myself, while the mechanism was constructed by the Victoria Foundry. It was found necessary, owing to the vibration of the secondary mirror support and carriage by the wind, to design one of a heavier pattern, which has been constructed by the same firm since the photographs were made, and entirely overcomes the difficulty.

The definition given by this equipment is much better than was expected from the somewhat unfavourable conditions, such as the low position of the coelostat, and the presence of the unventilated tunnel through which the beam passes. Its location north of the Observatory is also objectionable on account of radiation or convection from the building, affecting the beam between coelostat and sun. However, as the position of the installation was the only one available, we were forced to make the best of these adverse conditions and as the result shows successfully. In the early morning and the late afternoon when the mirrors are in their normal condition the definition is very good, but this is soon deteriorated by the irregular figure produced by the heating action of the sun on the mirrors. However, by keeping them shielded from the sun's rays except during actual use, this causes no especial difficulty in solar rotation work.

RADIAL VELOCITIES.

The work of determining the radial velocities of stars has been actively carried on during the last year, the addition to the staff enabling a considerable increase in the number of measurements made, and in the amount of computational work accomplished. So far as observing is concerned, however, the weather has not been as good as in the previous year. In April and May there were considerably fewer observing nights, many of them also being rendered practically useless by haze. June, July and August were good, but they were followed by three months in which very few useful spectra were obtained owing to continuous dense smoke at first and afterwards to cloudy weather. The remainder of the year has been of about average quality. There have been photographed in the year, 1,010 spectra, 18 sun for use with the spectro-comparator and 992 star spectra on 160 nights. Of these 218 have been made with the three-prism, 698 with the one-prism and 94 with the new one-prism spectrograph.

Of these spectra, 775 have been measured and reduced. Probably a number of spectra made previous to April 1, 1908, have also been measured during the past year, but we have no record of the exact number.

Detailed measures, which in this report have all been collected together at the end (Appendix E), have been made of 635 plates, of which 581 are used in obtaining the orbits of the five binary stars discussed below. The other 54 are measures of two stars whose orbits are not yet completed. The remaining 138 plates measured are chiefly of spectroscopic binaries under investigation, but they also include a number of plates of some early type stars not known to be binaries.

The five binaries discussed below with the number of plates used for each are:—

| Star.                         | Right Ascension |      | Declination. | No. of Plates.   |
|-------------------------------|-----------------|------|--------------|------------------|
|                               | h.              | m.   |              |                  |
| $\beta$ Orionis.....          | 5               | 10   | - 8° 19'     | 273              |
| $\theta$ Aquilæ.....          | 20              | 06.2 | - 1 7        | 54, + 43 in 1908 |
| $\alpha$ Coronæ Borealis..... | 15              | 30.4 | +27 3        | 103              |
| $\epsilon$ Herculis.....      | 16              | 56.5 | +31 4        | 106              |
| $\eta$ Boëtis.....            | 13              | 49.9 | +18 54       | 45               |

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The 34 measures of  $\delta$  Aquilæ which follow are given for the reason that there seems little prospect of obtaining an orbit and little use, owing to the uncertainty of the results and the small range in velocity, in carrying the work on this star any further.

The binaries under observation here at present are given in the following table. In two of these stars  $\tau$  Tauri, B.D. - 1° 1004, and  $\nu$  Orionis, the work is well advanced, but on many of the others not much has yet been done:—

## BINARIES UNDER OBSERVATION.

| —                             | R. A. |      | Declination. |    | Mag. | Type.   |
|-------------------------------|-------|------|--------------|----|------|---------|
|                               | h.    | m.   | "            | "  |      |         |
| $\phi$ Persei .....           | 1     | 37   | + 50         | 11 | 4.3  | I a 2   |
| $\tau$ Tauri .....            | 4     | 36   | + 22         | 36 | 4.2  | I b     |
| $\gamma$ Camelopardalis ..... | 4     | 49.3 | + 53         | 35 | 4.7  | VII a   |
| B. D. - 1° 1004 .....         | 5     | 36   | - 1          | 11 | 5.1  | I b     |
| $\nu$ Orionis .....           | 6     | 1.8  | + 14         | 47 | 4.6  | IV a, b |
| $\gamma$ Geminorum .....      | 6     | 31.9 | + 16         | 9  | 2.9  | VIII a  |
| $\omega$ Ursæ Majoris .....   | 10    | 48.2 | + 43         | 43 | 4.7  | I a 2   |
| 93 Leonis .....               | 11    | 43   | + 20         | 46 | 4.8  | XII     |
| $\gamma$ Corvi .....          | 12    | 11   | - 16         | 59 | 3.3  | VI a    |
| $\delta$ Herculis .....       | 17    | 11   | + 24         | 57 | 3.7  | VII b   |
| B. A. C. - 5890 .....         | 17    | 21.3 | - 5          | 0  | 4.8  | XII     |
| $\alpha$ Ophiuchi .....       | 17    | 30   | + 12         | 37 | 2.9  | XIII b  |
| $\gamma$ Aquarii .....        | 22    | 16   | - 1          | 53 | 4.1  | VII a   |

The majority of these stars have, as will be noticed, early type spectra and in many of them the lines are very diffuse; consequently many plates are required before a satisfactory orbit can be obtained, an example of this being given in the preceding table of the binaries completed, where the average number of plates used is well over 100.

In the measures of stars not known to be binaries, those that were observed having in every case spectra of the hydrogen or helium type generally with diffuse lines, the following four stars were discovered to be variable in their velocity:—

## NEW SPECTROSCOPIC BINARIES.

| Star.                      | R. A. |      | Declination. |    | Mag. | Type. |
|----------------------------|-------|------|--------------|----|------|-------|
|                            | h.    | m.   | "            | "  |      |       |
| $\delta$ Herculis .....    | 17    | 11   | + 24         | 57 | 3.7  | VII b |
| $\gamma$ Aquarii .....     | 22    | 16.5 | - 1          | 53 | 4.1  | VII a |
| $\epsilon$ Andromedæ ..... | 23    | 33.2 | + 42         | 43 | 4.4  | A     |
| $\xi$ Persei .....         | 3     | 52.4 | + 35         | 30 | 4.4  | I b   |

In addition to the above,  $\beta$  Orionis is definitely announced as of binary character, but as it is more fully discussed later, nothing more need be said about it here.

 $\delta$  Herculis.

Practically the only lines measurable in this spectrum are the hydrogen series, and these are very diffuse and difficult to measure. Consequently, the measures are

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subject to much uncertainty, and it was only after several plates had been obtained that its binary character was established. The velocities are as follows:—

| Plate Number. | Date.      | Velocity. | Plate Number. | Date.       | Velocity. |
|---------------|------------|-----------|---------------|-------------|-----------|
| 1907.         |            |           | 1908.         |             |           |
| 839           | June 12 79 | 27        | 1404          | March 16 93 | - 44      |
| 894           | " 27 74    | - 9       | 1480          | April 13 83 | - 73      |
| 929           | July 9 66  | 35        | 1495          | " 15 89     | - 47      |
| 1908.         |            |           | 1512          | " 22 89     | - 57      |
| 1392          | March 8 89 | - 59      | 1532          | May 15 85   | - 47      |
|               |            |           | 1541          | " 18 81     | 18        |

The variability in its velocity was discovered by Mr. Harper.

*γ Aquarii.*

This star is of the hydrogen type, having *Mg.* 4481, *Fe* 4549, *Ca* 3934, in addition to the hydrogen lines, and the measures are consequently much more reliable than the previous star. They are:

| Plate Number. | Date.       | Velocity. | Plate Number. | Date.        | Velocity. |
|---------------|-------------|-----------|---------------|--------------|-----------|
| 1908.         |             |           | 1908.         |              |           |
| 1745          | July 29 86  | 18        | 1790          | August 17 81 | - 40      |
| 1770          | August 5 81 | - 8       | 1847          | " 28 70      | - 7       |
| 1779          | " 7 81      | + 3       | 1858          | " 31 77      | + 23      |

Its variability was discovered by Mr. Cannon.

*ι Andromeda.*

The spectrum of this star is similar to that of *γ Aquarii*, having the hydrogen *Mg.* 4481, and *K* lines, although possibly not so well defined. Its variability was discovered by Mr. Cannon, and it was announced in the *Journal of the Royal Astronomical Society of Canada*, Vol. II., No. 5. I learned afterwards that it had been informally announced by Prof. Frost at the Put-in-Bay meeting of the Astronomical and Astrophysical Society of America. Although present at the meeting, I had taken no notes and had forgotten its announcement. The discovery here was consequently entirely independent. The velocities of all the plates measured here are given:

| Plate Number. | Date.        | Velocity. | Plate Number. | Date.         | Velocity. |
|---------------|--------------|-----------|---------------|---------------|-----------|
| 1908.         |              |           | 1908.         |               |           |
| 1772          | August 5 87  | 6         | 1954          | November 9 58 | 0         |
| 1781          | " 7 87       | 11        | 1963          | " 13 60       | + 14      |
| 1832          | " 26 87      | + 12      | 1969          | " 16 69       | + 29      |
| 1922          | October 9 76 | 36        | 1971          | " 20 59       | - 13      |
| 1928          | " 12 71      | 14        | 1977          | " 21 53       | + 7       |
| 1939          | " 19 63      | 6         | 1995          | December 2 55 | + 1       |

ξ *Persei*.

The spectrum of this star is of the helium type, and is principally characterized by the extreme breadth and diffuseness of the lines. Frost and Adams, in 1903, published the measures of some plates which agreed well within errors of observation in giving it a positive velocity of 85km. per second. They surmised that later plates might show the velocity to be variable. Consequently, I thought it desirable to obtain a few plates here, and their measures by Mr. Cannon soon showed that the star was a binary. I have since learned personally from Prof. Frost that this had been a long time established by them. The following are all the velocities measured here:—

| Plate Number. | Date, G. M. T. | Velocity. | Plate Number. | Date, G. M. T. | Velocity. |
|---------------|----------------|-----------|---------------|----------------|-----------|
|               | 1908.          |           |               | 1908.          |           |
| 1946          | October 30 37  | - 120     | 1974          | November 20 83 | + 45      |
| 1953          | November 6 66  | - 143     | 1998          | December 2 69  | - 32      |
| 1958          | " 9 77         | - 54      | 1999          | " 4 72         | - 51      |
| 1964          | " 13 65        | - 2       |               |                |           |

δ *Aquilæ*.

Mr. Parker has spent considerable time at work on δ *Aquilæ* without being able to obtain a period, and it looks as if the small range, combined with the poor quality of the spectrum, will prevent any orbit being determined. Mr. Parker has also been unfortunate in the other binary on which he has been engaged,  $\tau$  *Tauri*, which has very bad lines in its spectrum and over which he has spent a great deal of time. He has, however, determined the period as nearly 1.5 days, but it has not been thought desirable to complete the work until further plates are secured next season. Consequently no measures of it will be given in this report, but a summary of the measures and some data concerning δ *Aquilæ* are given below, while the detailed measures are given in Appendix E.

This star ( $\alpha = 19^h 20^m.5$ ,  $\delta = 2^\circ 55'$ ) was discovered to be of variable velocity by Campbell and Curtis from observations made at the Lick Observatory in 1900-03.\* Observations were begun upon it here in August, 1906, and since then some thirty-four plates have been measured and computed. δ *Aquilæ* is taken as the typical star in Group XI., according to Miss Maury's classification.† The principal lines in the spectrum are those of hydrogen, iron, magnesium and titanium. All, and especially those of hydrogen, are broad and not defined, the region measured being from  $H_3$  to  $\lambda 4005$ . These will be found in Table I. The range of resulting radial velocities, as seen in Table II, is not large ( - 15 to - 47kms.), and, as yet the period cannot be determined from the curve of the present observations.

\* L.O.B., 1903, A. J. XVIII., 306.

† Annals Harvard College Observatory, Vol. 28.



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TABLE I.  
PRINCIPAL LINES MEASURED IN  $\delta$  AQUILÆ.

| Wave-Length.  | Element.   | Wave-Length.  | Element. |
|---------------|------------|---------------|----------|
| 4861.527..... | H          | 4274.922..... | Ti & Cr  |
| 4549.766..... | Fe & Ti    | 4271.760..... | Fe       |
| 4534.139..... | Ti         | 4260.640..... | Fe       |
| 4501.448..... | Ti         | 4246.996..... | Y        |
| 4481.400..... | Mg         | 4227.010..... | Fe       |
| 4443.976..... | Ti         | 4216.351..... | Fe       |
| 4404.927..... | Fe         | 4198.494..... | Fe       |
| 4395.286..... | Ti, V, Zy. | 4143.928..... | Fe       |
| 4374.905..... | Ti         | 4102.000..... | H        |
| 4340.634..... | H          | 4071.901..... | Fe       |
| 4325.939..... | Fe         | 4063.756..... | Fe       |
| 4320.992..... | Sc         | 4045.975..... | Fe       |
| 4282.722..... | Fe         | 4005.429..... | Fe       |

TABLE II.  
TABLE OF OBSERVATIONS OF  $\delta$  AQUILÆ.

| Plate.        | Date, G. M. T.          | Velocity.  |
|---------------|-------------------------|------------|
| 368.....      | 1906, August, 6.73      | -41.8 kms. |
| 377.....      | " " 15.65               | 45.2       |
| 382.....      | " " 24.65               | 45.1       |
| 390.....      | Sept. 10.64             | 25.0       |
| 399.....      | " " 27.61               | 29.0       |
| 413.....      | Oct. 23.57              | 37.7       |
| 803.....      | 1907, May, 31.79        | 29.9       |
| 818.....      | June <sub>2</sub> 10.80 | 12.8       |
| 904.....      | July, 2.76              | 19.5       |
| 923.....      | " " 8.75                | 28.0       |
| 930.....      | " " 9.68                | 15.6       |
| 938.....      | " " 10.68               | 18.5       |
| 966.....      | " " 25.68               | 16.5       |
| 980.....      | Aug. 3.61               | 25.7       |
| 982.....      | " " 5.68                | 29.4       |
| 1034.....     | Sept. 6.65              | 25.4       |
| 1049 (a)..... | " " 18.58               | 25.9       |
| 1049 (b)..... | " " 18.58               | 28.0       |
| 1543.....     | 1908, May, 18.83        | 21.9       |
| 1550.....     | " " 22.85               | 40.1       |
| 1575.....     | June, 3.83              | 28.2       |
| 1575.....     | " " 3.83                | 31.6       |
| 1584.....     | " " 5.85                | 35.5       |
| 1633.....     | " " 24.77               | 29.5       |
| 1642.....     | " " 26.78               | 39.8       |
| 1650.....     | " " 27.75               | 40.9       |
| 1660.....     | July, 3.77              | 21.9       |
| 1678.....     | " " 8.75                | 36.4       |
| 1690.....     | " " 10.77               | 26.1       |
| 1695.....     | " " 11.77               | 34.6       |
| 1703.....     | " " 13.78               | 47.0       |
| 1753.....     | " " 31.69               | 30.7       |
| 1754.....     | " " 31.72               | 39.1       |
| 1768.....     | August, 5.75            | 29.7       |
| 1783.....     | " " 15.73               | 31.9       |
| 1837.....     | " " 27.62               | -39.5      |

THE ORBIT OF  $\beta$  ORIONIS.

As was mentioned in my report of last year, under a description and discussion of the effect of slit-width on the errors of setting, this star showed such a difference in the mean velocities obtained on two nights (mean of 10 plates on March 20, 24.9km.; mean of 12 plates on March 24, 20.6km.) as to lead to a strong suspicion of the variability of its velocity. This suspicion was strengthened by plates obtained on other nights up to April 13, 1908, and it was decided on account of its brightness and its interesting history to follow it closely as soon as it again came into position where it could be observed.

The radial velocity of  $\beta$  Orionis was first determined at Potsdam by Vogel and Scheiner\* in the years 1888-1891, in the beginning of photographic determinations of radial velocity. From their measures of the 14 plates, velocities varying between about +3 and +34kms. per second were obtained. They suspected a variation in the star's velocity due to orbital motion, but were unable to obtain evidence of its periodicity, and the accuracy of these early measures was scarcely sufficiently high to decide the question. The next published measures of the star's velocity were by Frost and Adams† from plates obtained in 1901-1902. They found values ranging between +14.9 and +23.4km., but they attributed this range to the character of the lines in the star's spectrum and concluded that their results showed no indication of variability in velocity. The measures of 5 plates of  $\beta$  Orionis obtained at the Lick Observatory‡ indicate a range of 10km. from +15 to +25km., in its velocity, but Campbell and Curtis in discussing these measures attribute this range to the small number of lines available, to their poor quality, and to over-exposure of some of the negatives. They consider that proper exposure would considerably reduce the observed range, and conclude that their results do not give any evidence of variability of velocity. However, a recent personal communication from Prof. Campbell informs me that they have suspected variation, but owing to press of their regular programme have not followed up the matter.

There seemed to be no question of the smallness of the range in velocity, if any, and it was evident that the only hope of obtaining anything definite, considering this and the fairly large accidental errors of a velocity determination owing to the character of the lines of the spectrum, was to obtain several plates on each night the star was observed and use their mean velocity as the velocity of the star at their mean epoch. As the star is bright, a spectrum can be obtained in ten minutes or less with the three-prism spectrograph, and in about two minutes with the one-prism. Consequently not much time is required to obtain half a dozen plates and unless the period is very short no error due to change of phase can enter. The probable error of a night's observation will by this means be considerably reduced and a much better chance obtained of determining its period of variation.

Plates were accordingly obtained whenever possible until the star became inaccessible in April, 1908, and observations were continued during the present season until March 23, 1909. Owing to the very smoky and cloudy weather last fall, very few plates were obtained until December. In all 273 plates, obtained on 54 nights, have been used in this discussion. Of these 150 were made with a dispersion of three prisms, 123 with one prism. The investigation on slit-width in the last report showed that lower probable errors were obtained with the higher dispersion and it was used wherever possible. However, the star was also observed with the one-prism spectrograph when our programme would not permit the use of three prisms. Three-fourths of the observations and all the measurements were made by myself in order to avoid as far as possible any chance of systematic discrepancies.

\*Pot-dam Publications, Band VII., p. 136.

† Publications of the Yerkes Observatory, 2, 61.

‡ Lick Observatory Bulletin No. 70.

## SESSIONAL PAPER No. 25a

The star  $\beta$  Orionis is of the helium type, Miss Maury's V.L.c, and has fairly well defined lines of hydrogen and helium, the magnesium  $\lambda$  4481 and the calcium *H* and *K*. It also contains lines due to silicon, oxygen and carbon and a few faint metallic lines. In my early measures for slit-width effect eight lines were measured in the three-prism plates and seven in the single-prism plates.

*Lines measured in  $\beta$  Orionis.*

| Three-Prism Plates. | One-Prism Plates. |
|---------------------|-------------------|
| 4862 <i>H</i>       | 4862 <i>H</i>     |
| 4481 <i>Mg</i>      | 4481 <i>Mg</i>    |
| 4472 <i>He</i>      | 4472 <i>He</i>    |
| 4388 <i>He</i>      | 4341 <i>H</i>     |
| 4341 <i>H</i>       | 4102 <i>H</i>     |
| 4131 <i>Si</i>      | 4026 <i>He</i>    |
| 1128 <i>Si</i>      | 3934 <i>Ca</i>    |
| 4102 <i>H</i>       |                   |

It was found, however, that lower probable errors were obtained where the three best lines  $\lambda$  4481, 4472, 4341 only were used than when more or all of the measured lines were discussed. Consequently in the later plates only the three lines mentioned above have been measured and in general four comparison lines, thus considerably lightening the labour. Considerable difference in the quality of the negatives for measurement, even when taken under, so far as could be judged, identical conditions, has been noticed; this difference seems to lie principally in the character of the lines themselves. They are sometimes sharply defined and symmetrical, at others not so sharp and apparently stronger at one side. Sometimes also the contrast between them and the continuous spectrum appears considerably diminished. These changes seem almost too marked to be due entirely to instrumental or photographic effects, and one would be inclined to attribute part at any rate to changes in the spectrum. No evidence can be found, however, of any dependence of this quality of the lines upon the phase of the orbit.

In the measurements the lines were weighted according to their apparent quality and the weighted mean velocity used. In combining the separate plates on each night they were also weighted, partly according to their quality and partly according to the internal agreement of the measures, and finally the resultant mean velocity for the night was similarly weighted for use in the grouping and discussion.

The record of the observations and the individual plate measures are given in Appendix E, where all the measures are collected together, while a summary of the velocities, &c., is given in the following table:—

## β ORIONIS.

## SUMMARY OF MEASURES.

| Plate Number. | Date.      | G. M. T. | Julian Date. | Velocity. | Residual. |
|---------------|------------|----------|--------------|-----------|-----------|
|               | 1908.      |          |              |           |           |
| 1241 a.       | January 20 | 15 02    | 2,417.961 63 | +23 3     | + 2.4     |
| 1241 b.       | " 20       | 15 06    | 961 63       | +20 9     | + 0.0     |
| 1241 c.       | " 20       | 15 10    | 961 63       | +25 4     | + 4.5     |
| 1242 a.       | " 20       | 15 12    | 961 63       | +23 7     | + 2.8     |
| 1242 b.       | " 20       | 15 15    | 961 64       | +25 9     | + 5.0     |
| 1242 c.       | " 20       | 15 18    | 961 64       | +19 7     | - 1.2     |
| 1243 a.       | " 20       | 15 24    | 961 64       | +21 3     | + 0.4     |
| 1243 b.       | " 20       | 15 27    | 961 65       | +23 5     | + 2.6     |
| 1243 c.       | " 20       | 15 30    | 961 65       | +24 8     | + 3.9     |
| 1244 a.       | " 20       | 15 43    | 961 66       | +24 5     | + 3.6     |
| 1244 b.       | " 20       | 15 47    | 961 66       | +16 5     | - 4.4     |
| 1244 c.       | " 20       | 15 50    | 961 66       | +26 4     | + 5.5     |
| 1245 a.       | " 20       | 15 52    | 961 66       | +25 0     | + 4.1     |
| 1245 b.       | " 20       | 15 54    | 961 66       | +21 8     | + 0.9     |
| 1245 c.       | " 20       | 15 56    | 961 66       | +20 5     | - 0.4     |
| 1247 a.       | " 20       | 16 15    | 961 68       | +23 8     | - 2.9     |
| 1247 b.       | " 20       | 16 17    | 961 68       | +31 3     | +10.4     |
| 1247 c.       | " 20       | 16 19    | 961 68       | +19 0     | - 1.9     |
| 1248 a.       | " 20       | 16 25    | 961 68       | +11 6     | - 9.3     |
| 1248 b.       | " 20       | 16 27    | 961 68       | + 5 8     | -15.1     |
| 1248 c.       | " 20       | 16 29    | 961 68       | +36 1     | +15.2     |
| 1249 a.       | " 20       | 16 35    | 961 69       | +14 0     | - 6.9     |
| 1249 b.       | " 20       | 16 37    | 961 69       | +16 0     | - 4.9     |
| 1249 c.       | " 20       | 16 39    | 961 69       | +24 2     | + 3.3     |
| 1285 a.       | " 27       | 15 45    | 968 68       | +15 3     | - 5.8     |
| 1285 b.       | " 27       | 15 51    | 968 66       | +19 2     | - 1.9     |
| 1285 c.       | " 27       | 15 57    | 968 67       | +17 9     | - 3.2     |
| 1286 a.       | " 27       | 16 03    | 968 67       | +21 3     | + 0.2     |
| 1286 b.       | " 27       | 16 09    | 968 67       | +18 7     | - 2.4     |
| 1286 c.       | " 27       | 16 15    | 968 67       | +24 3     | + 3.2     |
| 1289 a.       | " 27       | 17 13    | 968 72       | +18 1     | - 3.0     |
| 1289 b.       | " 27       | 17 17    | 968 72       | +19 9     | - 2.3     |
| 1289 c.       | " 27       | 17 21    | 968 72       | +27 8     | + 6.6     |
| 1290 a.       | " 27       | 17 24    | 968 73       | +15 6     | - 5.6     |
| 1290 b.       | " 27       | 17 28    | 968 73       | +21 6     | + 0.4     |
| 1290 c.       | " 27       | 17 32    | 968 73       | +16 1     | - 5.1     |
| 1405.         | March 20   | 11 51    | 2,418.021 50 | +23 1     | - 1.4     |
| 1406.         | " 20       | 12 07    | 021 50       | +24 3     | - 0.2     |
| 1407.         | " 20       | 12 21    | 021 51       | +21 4     | - 3.1     |
| 1408.         | " 20       | 12 32    | 021 52       | +24 9     | - 0.1     |
| 1409.         | " 20       | 12 46    | 021 53       | +28 0     | - 3.5     |
| 1410.         | " 20       | 13 00    | 021 54       | +23 3     | - 1.2     |
| 1411.         | " 20       | 13 12    | 021 55       | +23 5     | - 1.0     |
| 1412.         | " 20       | 13 27    | 021 56       | +24 9     | + 0.4     |
| 1413.         | " 20       | 13 47    | 021 57       | +27 5     | + 3.0     |
| 1414.         | " 20       | 13 57    | 021 58       | +26 9     | + 2.4     |
| 1426.         | " 24       | 12 03    | 025 50       | +19 2     | - 2.9     |
| 1427.         | " 24       | 12 15    | 025 51       | +21 1     | - 1.0     |
| 1428.         | " 24       | 12 23    | 025 52       | +19 2     | - 2.9     |
| 1429.         | " 24       | 12 36    | 025 52       | +21 6     | - 0.5     |
| 1430.         | " 24       | 12 42    | 025 53       | +18 8     | - 3.3     |
| 1431.         | " 24       | 12 52    | 025 53       | +18 6     | - 3.5     |
| 1433.         | " 24       | 13 16    | 025 55       | +17 5     | - 4.6     |
| 1434.         | " 24       | 13 32    | 025 56       | +19 3     | - 2.8     |
| 1435.         | " 24       | 13 39    | 025 57       | +16 1     | - 6.0     |
| 1436.         | " 24       | 13 46    | 025 57       | +17 2     | - 4.9     |
| 1437.         | " 24       | 13 56    | 025 58       | +18 7     | - 3.4     |
| 1438.         | " 24       | 14 07    | 025 58       | +18 0     | - 4.1     |
| 1439.         | " 30       | 12 19    | 031 51       | +14 4     | - 4.1     |
| 1440.         | " 30       | 12 29    | 031 52       | +14 4     | - 4.1     |
| 1441.         | " 30       | 12 38    | 031 53       | +14 5     | - 4.0     |
| 1442.         | " 30       | 12 49    | 031 53       | +17 0     | - 1.5     |
| 1448.         | April 3    | 12 16    | 035 51       | +24 9     | + 1.5     |
| 1449.         | " 3        | 12 28    | 035 52       | +27 9     | + 4.5     |
| 1450.         | " 3        | 12 40    | 035 53       | +32 2     | + 8.7     |
| 1451.         | " 3        | 12 53    | 035 53       | +27 1     | + 3.6     |

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 $\beta$ ORIONIS.SUMMARY OF MEASURES *Continued.*

| Plate Number. | Date.           | G. M. T. | Julian Date. | Velocity. | Residual. |
|---------------|-----------------|----------|--------------|-----------|-----------|
| 1908.         |                 |          |              |           |           |
| 1457          | April .....     | 4 12 19  | 2,418.036 51 | +29.9     | + 5.0     |
| 1458          | " .....         | 4 12 28  | 036 52       | +27.4     | + 2.5     |
| 1459          | " .....         | 4 12 37  | 036 53       | +27.0     | + 2.1     |
| 1469          | " .....         | 13 12 10 | 045.51       | +21.3     | - 2.0     |
| 1470          | " .....         | 13 12 22 | 045 52       | +25.0     | + 1.7     |
| 1471          | " .....         | 13 12 34 | 045 52       | +24.8     | + 1.5     |
| 1873          | September ..... | 7 21 52  | 192 92       | +28.2     | + 2.2     |
| 1874          | " .....         | 7 22 10  | 192 93       | +27.1     | + 1.1     |
| 1935          | October .....   | 13 21 19 | 228 90       | +18.3     | - 0.2     |
| 1936          | " .....         | 13 21 48 | 228 91       | +17.0     | - 1.5     |
| 1937          | " .....         | 13 22 19 | 228 93       | +17.5     | - 1.0     |
| 1938          | " .....         | 13 22 47 | 228 95       | +14.3     | - 4.2     |
| 1978          | November .....  | 21 18 24 | 267 77       | +17.0     | - 4.2     |
| 1979          | " .....         | 21 18 43 | 267 78       | +17.3     | - 3.9     |
| 1980          | " .....         | 21 19 05 | 267 79       | +24.5     | - 3.3     |
| 1981          | " .....         | 21 19 33 | 267 81       | +25.0     | + 3.8     |
| 1984          | " .....         | 28 16 05 | 274 67       | +21.0     | - 0.9     |
| 1985          | " .....         | 28 16 34 | 274 69       | +22.7     | + 2.6     |
| 1986          | " .....         | 28 17 08 | 274 71       | +20.5     | - 0.4     |
| 1987          | December .....  | 1 17 53  | 277 75       | +16.4     | - 8.9     |
| 1988          | " .....         | 1 18 18  | 277 76       | +20.9     | - 4.4     |
| 1989          | " .....         | 1 18 36  | 277 77       | +16.1     | - 9.2     |
| 1990          | " .....         | 1 18 52  | 277 78       | +23.1     | - 2.2     |
| 2003          | " .....         | 5 16 10  | 281 67       | +22.6     | - 3.1     |
| 2004          | " .....         | 5 16 22  | 281 68       | +25.1     | - 0.6     |
| 2005          | " .....         | 5 16 38  | 281 69       | +25.6     | - 0.1     |
| 2006          | " .....         | 5 16 53  | 281 70       | +27.5     | - 0.8     |
| 2054          | " .....         | 21 15 24 | 297 64       | +21.5     | - 0.6     |
| 2055          | " .....         | 21 15 29 | 297 65       | +21.9     | - 0.2     |
| 2057          | " .....         | 21 16 54 | 297 70       | +25.7     | + 3.6     |
| 2058          | " .....         | 21 17 00 | 297 71       | +22.0     | - 0.1     |
| 2065          | " .....         | 22 17 38 | 298 73       | +28.1     | + 4.0     |
| 2066          | " .....         | 22 17 52 | 298 74       | +21.7     | - 2.4     |
| 2067          | " .....         | 22 18 02 | 298 75       | +23.1     | - 1.0     |
| 2068          | " .....         | 22 18 14 | 298 76       | +23.2     | - 0.9     |
| 2070          | " .....         | 23 14 01 | 2 9 58       | +20.9     | - 4.3     |
| 2071          | " .....         | 23 14 41 | 299 61       | +26.8     | + 1.6     |
| 2072          | " .....         | 23 15 08 | 299 63       | +23.5     | - 1.7     |
| 2073          | " .....         | 23 15 20 | 299 64       | +21.2     | - 4.0     |
| 2075          | " .....         | 26 15 50 | 302 66       | +25.6     | - 0.4     |
| 2076          | " .....         | 26 16 00 | 302 67       | +25.9     | - 0.1     |
| 2077          | " .....         | 26 16 09 | 302 67       | +22.5     | - 3.5     |
| 2078          | " .....         | 26 16 18 | 302 68       | +22.0     | - 4.0     |
| 2079          | " .....         | 27 14 07 | 303 59       | +33.2     | - 7.6     |
| 2080          | " .....         | 27 15 12 | 303 64       | +29.7     | - 4.1     |
| 2082          | " .....         | 31 15 19 | 307 64       | +22.7     | - 1.0     |
| 2083          | " .....         | 31 15 23 | 307 64       | +24.7     | + 1.0     |
| 2084          | " .....         | 31 15 29 | 307 65       | +23.0     | - 0.7     |
| 2085          | " .....         | 31 15 57 | 307 67       | +20.5     | + 2.8     |
| 1909.         |                 |          |              |           |           |
| 2092          | January .....   | 6 16 49  | 2,418.313 70 | +19.1     | - 0.7     |
| 2093          | " .....         | 6 16 53  | 313 70       | +19.6     | - 0.2     |
| 2094          | " .....         | 6 17 13  | 313 72       | +18.5     | - 1.3     |
| 2095          | " .....         | 6 17 16  | 313 72       | +21.2     | + 1.4     |
| 2105          | " .....         | 7 12 49  | 314 53       | +16.8     | - 2.4     |
| 2106          | " .....         | 7 13 01  | 314 54       | +21.9     | - 2.7     |
| 2107          | " .....         | 7 13 04  | 314 54       | +12.8     | - 7.1     |
| 2108          | " .....         | 7 13 07  | 314 54       | +20.7     | + 1.5     |
| 2111          | " .....         | 7 16 27  | 314 69       | +19.2     | 0.0       |
| 2112          | " .....         | 7 16 37  | 314 69       | +16.6     | - 2.6     |
| 2114          | " .....         | 7 16 56  | 314 71       | +17.8     | - 1.4     |
| 2117          | " .....         | 8 15 48  | 315 66       | +18.9     | + 0.2     |
| 2118          | " .....         | 8 15 52  | 315 66       | +20.3     | + 1.6     |
| 2122          | " .....         | 12 11 55 | 319 50       | +26.5     | + 4.5     |
| 2123          | " .....         | 12 11 59 | 319 50       | +26.0     | + 4.0     |

## BORONIS.

SUMMARY OF MEASURES—*Continued.*

| Plate Number. | Date.      | G. M. T. | Julian Date. | Velocity. | Residual. |
|---------------|------------|----------|--------------|-----------|-----------|
|               | 1909.      |          |              |           |           |
| 2124          | January 12 | 12 09    | 2,418,319.51 | -20.5     | -1.5      |
| 2125          | " 12       | 12 12    | 319.51       | -21.3     | -0.7      |
| 2126          | " 12       | 12 15    | 319.51       | -27.2     | +5.0      |
| 2127          | " 12       | 12 18    | 319.51       | -25.5     | +3.5      |
| 2128          | " 13       | 15 36    | 320.65       | -30.2     | +6.1      |
| 2129          | " 13       | 15 41    | 320.65       | +15.7     | -8.4      |
| 2130          | " 13       | 15 46    | 320.66       | -28.8     | +4.7      |
| 2141          | " 15       | 14 51    | 322.62       | +18.6     | +7.3      |
| 2142          | " 15       | 15 11    | 322.63       | -24.5     | -1.4      |
| 2143          | " 15       | 15 15    | 322.63       | -27.2     | +1.3      |
| 2144          | " 15       | 15 19    | 322.64       | -21.8     | -4.1      |
| 2151          | " 16       | 12 25    | 323.52       | -31.4     | +5.3      |
| 2152          | " 16       | 12 36    | 323.52       | +27.6     | +1.5      |
| 2153          | " 16       | 12 44    | 323.53       | -34.4     | +8.3      |
| 2154          | " 16       | 12 52    | 323.53       | -40.9     | +14.8     |
| 2155          | " 16       | 12 59    | 323.54       | -33.0     | +6.9      |
| 2156          | " 16       | 13 12    | 323.55       | -35.8     | +9.7      |
| 2157          | " 17       | 13 48    | 324.57       | +29.9     | +3.9      |
| 2153          | " 17       | 13 56    | 324.58       | -26.2     | +0.2      |
| 2161          | " 18       | 12 41    | 325.53       | -37.1     | +11.5     |
| 2162          | " 18       | 12 46    | 325.53       | -31.3     | +5.7      |
| 2163          | " 18       | 12 51    | 325.53       | -28.3     | +2.7      |
| 2164          | " 18       | 13 06    | 325.54       | +35.8     | +10.2     |
| 2165          | " 18       | 13 10    | 325.55       | -31.2     | +5.6      |
| 2166          | " 18       | 13 14    | 325.55       | -30.5     | +4.9      |
| 2177          | " 26       | 10 36    | 333.44       | +24.6     | +3.4      |
| 2178          | " 26       | 10 51    | 333.45       | -17.8     | -3.4      |
| 2179          | " 26       | 10 56    | 333.46       | +24.9     | +3.7      |
| 2180          | " 26       | 11 01    | 333.46       | -23.5     | +2.3      |
| 2181          | " 26       | 11 11    | 333.47       | +22.4     | +1.2      |
| 2182          | " 26       | 11 16    | 333.47       | +16.2     | -5.0      |
| 2183          | " 26       | 11 21    | 333.47       | -20.5     | -0.7      |
| 2184          | " 28       | 11 21    | 335.47       | -16.3     | -3.6      |
| 2185          | " 28       | 11 25    | 335.48       | +22.2     | +3.3      |
| 2186          | " 28       | 11 29    | 335.48       | -14.2     | -5.7      |
| 2187          | " 28       | 11 41    | 335.48       | +14.3     | -5.6      |
| 2188          | " 28       | 11 44    | 335.49       | +10.6     | -9.3      |
| 2189          | " 28       | 11 47    | 335.49       | +18.4     | -0.9      |
| 2195          | " 29       | 12 53    | 336.54       | +14.9     | -4.3      |
| 2196          | " 29       | 12 57    | 336.54       | +17.9     | -1.3      |
| 2197          | " 29       | 13 01    | 336.54       | -26.4     | +7.2      |
| 2198          | " 29       | 13 05    | 336.54       | +22.1     | +2.9      |
| 2201          | " 30       | 12 29    | 337.52       | -14.0     | -4.7      |
| 2202          | " 30       | 12 41    | 337.53       | +17.3     | -1.4      |
| 2203          | " 30       | 12 45    | 337.53       | +25.0     | +6.3      |
| 2204          | " 30       | 12 48    | 337.53       | +14.2     | -4.5      |
| 2205          | " 30       | 15 47    | 337.66       | +21.0     | +2.3      |
| 2206          | " 30       | 16 04    | 337.67       | +22.6     | +4.1      |
| 2207          | " 30       | 16 24    | 337.68       | +22.3     | +3.8      |
| 2211          | " 31       | 17 16    | 338.72       | +19.8     | -1.2      |
| 2212          | " 31       | 17 20    | 338.72       | +23.2     | +4.6      |
| 2213          | " 31       | 17 24    | 338.73       | +16.6     | -2.6      |
| 2214          | " 31       | 17 29    | 338.73       | +16.6     | -2.0      |
| 2215          | February 2 | 11 14    | 340.47       | +24.8     | +4.6      |
| 2216          | " 2        | 11 23    | 340.48       | +23.1     | +2.9      |
| 2217          | " 2        | 11 26    | 340.48       | +23.6     | +3.4      |
| 2218          | " 2        | 11 29    | 340.48       | +22.5     | +2.3      |
| 2219          | " 2        | 11 41    | 340.49       | +16.5     | -3.7      |
| 2220          | " 2        | 11 45    | 340.49       | +21.5     | +1.3      |
| 2236          | " 6        | 12 29    | 344.52       | +18.2     | -7.7      |
| 2239          | " 6        | 12 50    | 344.53       | +20.0     | -5.9      |
| 2240          | " 6        | 12 52    | 344.53       | +21.0     | -4.9      |
| 2241          | " 6        | 16 12    | 344.68       | +21.9     | -4.0      |
| 2242          | " 6        | 16 43    | 344.70       | +19.1     | -6.8      |
| 2243          | " 7        | 15 11    | 345.63       | +21.0     | -5.1      |
| 2244          | " 7        | 15 25    | 345.64       | +21.9     | -4.2      |

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$\beta$  ORIONIS.

SUMMARY OF MEASURES. —Continued.

| Plate Number. | Date.      | G. M. T. | Julian Date. | Velocity. | Residual. |
|---------------|------------|----------|--------------|-----------|-----------|
|               | 1909       |          |              |           |           |
| 2245          | February 7 | 15 37    | 2,418,345.65 | +18.0     | - 8.1     |
| 2249          | " 8        | 13 32    | 346.56       | +31.6     | + 5.2     |
| 2250          | " 8        | 13 36    | 346.56       | +25.9     | 0.0       |
| 2251          | " 8        | 13 41    | 346.57       | +21.8     | - 4.1     |
| 2252          | " 8        | 14 01    | 346.58       | +17.6     | - 8.3     |
| 2253          | " 8        | 14 05    | 346.58       | +24.1     | - 1.8     |
| 2254          | " 8        | 14 09    | 346.59       | +23.3     | - 2.6     |
| 2265          | " 10       | 12 07    | 348.50       | +29.6     | + 4.4     |
| 2266          | " 10       | 12 12    | 348.51       | +23.3     | - 1.9     |
| 2267          | " 10       | 12 16    | 348.51       | +16.9     | - 8.3     |
| 2268          | " 10       | 12 21    | 348.51       | +12.8     | -12.4     |
| 2269          | " 10       | 12 33    | 348.52       | +20.3     | - 4.9     |
| 2270          | " 10       | 12 37    | 348.53       | +23.0     | - 2.2     |
| 2272          | " 11       | 11 26    | 349.48       | +18.9     | - 5.8     |
| 2273          | " 11       | 11 32    | 349.48       | +33.4     | + 8.7     |
| 2274          | " 11       | 11 35    | 349.48       | +30.8     | + 6.1     |
| 2275          | " 11       | 11 38    | 349.49       | +19.7     | - 5.0     |
| 2276          | " 11       | 11 46    | 349.49       | +17.3     | - 7.4     |
| 2277          | " 11       | 11 49    | 349.49       | +23.5     | - 1.2     |
| 2278          | " 13       | 12 27    | 351.52       | +22.2     | - 1.4     |
| 2279          | " 13       | 12 49    | 351.53       | +22.0     | - 1.6     |
| 2280          | " 13       | 12 53    | 351.54       | +21.1     | - 2.2     |
| 2284          | " 20       | 12 29    | 358.52       | +17.7     | - 1.4     |
| 2285          | " 20       | 13 05    | 358.54       | +22.6     | + 3.5     |
| 2286          | " 20       | 15 12    | 358.63       | +19.8     | + 0.7     |
| 2288          | " 21       | 12 51    | 359.53       | +21.0     | + 2.3     |
| 2289          | " 21       | 13 07    | 359.54       | +18.2     | - 0.5     |
| 2290          | " 21       | 13 17    | 359.55       | +18.4     | - 0.3     |
| 2291          | " 21       | 13 27    | 359.56       | +18.7     | 0.0       |
| 2292          | " 22       | 12 02    | 360.50       | +19.7     | + 1.1     |
| 2293          | " 22       | 12 15    | 360.51       | +25.1     | + 6.5     |
| 2294          | " 22       | 12 30    | 360.52       | +20.2     | + 1.6     |
| 2295          | " 22       | 12 45    | 360.53       | +20.2     | + 1.6     |
| 2309          | " 27       | 11 35    | 365.48       | +22.0     | - 3.4     |
| 2311          | " 28       | 11 56    | 366.50       | +22.2     | - 3.8     |
| 2312          | " 28       | 12 07    | 366.50       | +22.0     | - 4.0     |
| 2313          | " 28       | 12 18    | 366.51       | +23.7     | - 2.3     |
| 2314          | " 28       | 12 27    | 366.52       | +25.3     | - 0.7     |
| 2315          | " 28       | 12 39    | 366.53       | +22.4     | - 3.6     |
| 2316          | " 28       | 12 50    | 366.53       | +22.8     | - 3.2     |
| 2317          | March 2    | 11 05    | 368.46       | +25.9     | 0.0       |
| 2318          | " 2        | 11 19    | 368.47       | +24.4     | - 1.5     |
| 2319          | " 2        | 11 29    | 368.48       | +24.2     | - 1.7     |
| 2320          | " 3        | 11 36    | 368.48       | +21.6     | - 4.3     |
| 2364          | " 13       | 12 12    | 379.51       | +18.6     | - 1.1     |
| 2365          | " 13       | 12 24    | 379.52       | +18.4     | - 1.3     |
| 2366          | " 13       | 12 36    | 379.52       | +20.3     | + 0.6     |
| 2367          | " 13       | 12 46    | 379.53       | +17.6     | - 2.1     |
| 2368          | " 13       | 12 57    | 379.54       | +19.3     | - 0.4     |
| 2372          | " 15       | 11 45    | 381.49       | +16.9     | - 1.8     |
| 2373          | " 15       | 11 56    | 381.50       | +20.5     | + 1.8     |
| 2374          | " 15       | 12 05    | 381.50       | +17.6     | - 1.1     |
| 2375          | " 15       | 12 13    | 381.51       | +18.9     | + 0.2     |
| 2376          | " 15       | 12 21    | 381.52       | +16.2     | - 2.5     |
| 2386          | " 18       | 11 42    | 384.49       | +19.5     | - 1.1     |
| 2387          | " 18       | 11 52    | 384.50       | +20.0     | - 0.6     |
| 2388          | " 18       | 12 02    | 384.50       | +21.7     | + 1.1     |
| 2389          | " 18       | 12 12    | 384.51       | +21.0     | + 0.4     |
| 2390          | " 20       | 12 16    | 386.51       | +22.2     | - 2.1     |
| 2391          | " 20       | 12 26    | 386.52       | +18.3     | - 6.0     |
| 2392          | " 20       | 12 38    | 386.53       | +23.4     | - 0.9     |
| 2393          | " 20       | 12 48    | 386.53       | +21.9     | - 2.4     |
| 2394          | " 20       | 12 58    | 386.54       | +23.1     | - 1.2     |
| 2397          | " 21       | 13 38    | 387.56       | +23.9     | - 1.6     |
| 2398          | " 21       | 13 48    | 387.57       | +25.2     | - 0.3     |
| 2399          | " 21       | 14 00    | 387.58       | +24.8     | - 0.7     |

$\beta$  ORIONIS.SUMMARY OF MEASURES—*Continued.*

| Plate Number. | Date.          | G.M.T. | Julian Date. | Velocity. | Residual. |
|---------------|----------------|--------|--------------|-----------|-----------|
|               | 1909.          |        |              |           |           |
| 2400.....     | March . . . 21 | 14 14  | 2,418,387.59 | +25.5     | 0.0       |
| 2402.....     | " . . . 22     | 11 51  | 388.49       | +26.0     | 0.0       |
| 2403.....     | " . . . 22     | 12 02  | 388.50       | +25.0     | - 1.0     |
| 2404.....     | " . . . 22     | 12 13  | 388.51       | +21.1     | - 4.9     |
| 2405.....     | " . . . 22     | 12 35  | 388.52       | +21.2     | - 4.8     |
| 2420.....     | " . . . 23     | 11 46  | 389.49       | +23.1     | - 3.0     |
| 2421.....     | " . . . 23     | 11 57  | 389.50       | -24.4     | - 1.7     |
| 2422.....     | " . . . 23     | 12 05  | 389.50       | -25.9     | - 0.2     |
| 2423.....     | " . . . 23     | 12 13  | 389.51       | -26.2     | + 0.1     |
| 2424.....     | " . . . 23     | 12 27  | 389.52       | -25.5     | - 0.6     |
| 2425.....     | " . . . 23     | 12 38  | 389.53       | +25.7     | - 0.4     |

In the preceding table are given the plate number, the Greenwich mean and Julian dates, the weighted mean velocity for the plate, and finally the residual obtained by scaling from the final velocity curve. The velocities on each night were obtained by taking the weighted means of the plate velocities, the weights being assigned, as before stated, partly on the basis of apparent quality, partly according to the internal agreement of the measures. In the following table of mean velocities are given various data concerning the observations of each night, as the date, Julian date, velocity, phase, the number of plates, the dispersion used, the weight assigned and finally the residual obtained by scaling from the curve:—



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 $\beta$  ORIONIS.

## SUMMARY OF MEAN VELOCITIES PER NIGHT.

| Date.    | Julian Date. | Mean Velocity. | Mean Phase. | No. of Plates. | Spectrograph. | Weight. | Residual. |
|----------|--------------|----------------|-------------|----------------|---------------|---------|-----------|
| 1908.    |              |                |             |                |               |         |           |
| Jan. 20  | 2,417.961 65 | 22.3           | 0.65        | 24             | I L           | 16      | +1.40     |
| " 27     | 968.71       | 19.7           | 7.71        | 12             | III S         | 6       | -1.50     |
| March 20 | 2,418.021 54 | 24.9           | 16.74       | 10             | III L         | 10      | +0.45     |
| " 24     | 025.54       | 20.6           | 20.74       | 12             | "             | 6       | -1.47     |
| " 30     | 031.52       | 15.1           | 1.82        | 4              | "             | 6       | -3.46     |
| April 3  | 035.52       | 27.3           | 8.82        | 4              | "             | 4       | +3.87     |
| " 4      | 036.52       | 28.2           | 9.82        | 3              | "             | 3       | +3.28     |
| " 13     | 045.52       | 24.2           | 18.82       | 3              | "             | 3       | +0.93     |
| Sept. 7  | 192.92       | 27.1           | 12.92       | 2              | "             | 2       | +1.10     |
| Oct. 13  | 228.92       | 16.8           | 5.12        | 4              | "             | 5       | -1.76     |
| Nov. 21  | 267.79       | 22.3           | 0.19        | 4              | "             | 3       | +1.08     |
| " 28     | 274.60       | 21.4           | 7.09        | 3              | "             | 2       | +1.32     |
| Dec. 1   | 277.77       | 20.1           | 10.17       | 4              | "             | 1       | -5.19     |
| " 5      | 281.69       | 25.9           | 14.09       | 4              | "             | 2       | -1.36     |
| " 21     | 297.68       | 23.0           | 8.18        | 4              | I L           | 2       | +0.85     |
| " 22     | 298.75       | 24.0           | 9.25        | 4              | III L         | 2       | -0.10     |
| " 23     | 299.63       | 23.8           | 10.13       | 4              | "             | 2       | -1.43     |
| " 26     | 302.67       | 24.6           | 13.17       | 4              | "             | 3       | -1.36     |
| " 27     | 303.65       | 31.4           | 14.15       | 2              | "             | 2       | +5.77     |
| " 31     | 307.65       | 24.2           | 18.15       | 4              | I L           | 2       | +0.56     |
| 1909.    |              |                |             |                |               |         |           |
| Jan. 6   | 313.71       | 19.6           | 2.31        | 4              | I L           | 2       | -0.20     |
| " 7      | 314.62       | 17.9           | 3.22        | 7              | I & III       | 4       | -1.34     |
| " 8      | 315.66       | 19.6           | 4.26        | 2              | I L           | 1       | +0.87     |
| " 12     | 319.50       | 24.7           | 8.10        | 6              | "             | 3       | +2.70     |
| " 13     | 320.66       | 24.9           | 9.26        | 3              | "             | 1       | +0.77     |
| " 15     | 322.62       | 24.0           | 11.22       | 4              | "             | 1       | -1.93     |
| " 16     | 323.53       | 33.4           | 12.13       | 6              | "             | 3       | +7.30     |
| " 17     | 324.57       | 28.1           | 13.17       | 2              | "             | 1       | +2.15     |
| " 18     | 325.54       | 32.4           | 14.14       | 6              | "             | 3       | +6.78     |
| " 26     | 333.47       | 21.3           | 9.17        | 7              | "             | 4       | +0.08     |
| " 28     | 335.49       | 16.7           | 2.19        | 6              | "             | 2       | -3.18     |
| " 29     | 336.54       | 19.7           | 3.24        | 4              | "             | 1       | +0.46     |
| " 30     | 337.61       | 20.0           | 4.31        | 7              | I & III       | 5       | +1.28     |
| " 31     | 338.72       | 18.3           | 5.42        | 4              | I L           | 2       | -0.29     |
| Feb. 2   | 340.49       | 21.5           | 7.19        | 6              | "             | 4       | +1.30     |
| " 6      | 344.59       | 20.7           | 11.29       | 5              | I & III       | 3       | -5.26     |
| " 7      | 345.64       | 20.0           | 12.34       | 3              | III L         | 2       | -6.08     |
| " 8      | 346.57       | 24.7           | 13.27       | 6              | I L           | 2       | -1.23     |
| " 10     | 348.52       | 21.0           | 15.22       | 6              | "             | 1       | -4.17     |
| " 11     | 349.49       | 23.9           | 16.19       | 6              | "             | 1       | -0.83     |
| " 13     | 351.53       | 21.9           | 18.23       | 3              | III L         | 3       | -1.71     |
| " 20     | 358.57       | 19.4           | 3.37        | 3              | "             | 2       | -0.36     |
| " 21     | 359.55       | 19.2           | 4.35        | 4              | "             | 3       | +0.49     |
| " 22     | 360.52       | 20.0           | 5.32        | 4              | "             | 3       | +1.43     |
| " 27     | 365.48       | 22.0           | 10.28       | 1              | "             | 1       | -3.38     |
| " 28     | 366.53       | 22.8           | 11.33       | 6              | "             | 4       | -3.18     |
| March 2  | 368.47       | 23.4           | 13.27       | 4              | "             | 2       | -2.52     |
| " 13     | 379.53       | 18.8           | 2.43        | 5              | "             | 5       | -0.91     |
| " 15     | 381.50       | 18.0           | 4.40        | 5              | "             | 3       | -0.68     |
| " 18     | 384.50       | 20.55          | 7.40        | 4              | "             | 3       | -0.04     |
| " 20     | 386.53       | 22.2           | 9.43        | 5              | "             | 4       | -2.15     |
| " 21     | 387.57       | 24.85          | 10.47       | 4              | "             | 3       | -0.68     |
| " 22     | 388.51       | 23.3           | 11.41       | 4              | "             | 2       | -2.69     |
| " 23     | 389.51       | 25.1           | 12.41       | 6              | "             | 4       | -0.97     |

It was not difficult to trace periodic changes in the velocities thus determined, and comparatively early in the present season the period was found to be very nearly 21.90 days. The Potsdam observations, however, did not group themselves satisfactorily with this period, and owing to their probably inferior accuracy were not considered. The Yerkes observations showed a fairly satisfactory arrangement, although there were some discrepant single plates, due possibly to accidental errors of setting on the rather

broad lines of the spectrum, or to another cause to be referred to later on. The Lick observations, extending over seven years, followed the velocity curve determined as closely as could be expected, although as there are only five plates this agreement may be accidental. It was found, however, that a period of 21.87 instead of 21.90 days was required to bring the Lick observations forward to ours.

Although some discrepancies are to be expected on account of the small range in velocity and the relatively high errors of measurement, still it was felt that all the irregularities noted could not be explained on the above grounds. Consequently, although sufficient evidence had been secured of the binary character of  $\beta$  Orionis and sufficient data to obtain the elements of the orbit by the end of January, it was deemed desirable to continue the observations in the hope of finding a clue to some of the anomalies. The later observations revealed some peculiar and interesting features in the star's motion which served, if not to explain the cause of the irregularities, at least to indicate a reason for their existence.

The phase of minimum velocity due January 30-31 followed prediction, but the succeeding maximum, due February 6-7, although present, was of much lower amplitude than those previously obtained. The curve already drawn showed a range of velocity between about +17 and +29km. The maximum of February 6 reached only about 23km., and the succeeding minima and maxima until the end of the observations were as follows:—+ 19.5, + 23.0; + 18.5, + 24.5; 19.0, + 24.5. All of these values, as well as the previous ones, depend upon several plates, and there is no doubt in my mind that they indicate, if not a change in the amplitude of the velocity curve, certainly some progressive shift in the position of the absorption maximum of the lines measured due to some physical cause in the star's atmosphere. If it is a change in the amplitude of the motion, it may be due to the presence of a third body and will probably be periodic. If an epoch of low amplitude occurred in 1901-1902 this, together with the fact of their only making one plate per night and the consequently higher accidental errors, would form a sufficient explanation why Frost and Adams with the high accuracy of their work were unable to find any periodicity in the motion. Furthermore, a change in the amplitude is probably accompanied by changes in the other elements of the orbit, which may account for the slight change in the period requisite when the Lick observations are brought up to the same epoch as those at Ottawa.

If all the Ottawa observations are plotted continuously on cross-section paper, they form a curve somewhat similar to the trace given by two beating tuning forks. It shows curves similar to the velocity curve of Fig. (16) periodically repeated with gradually increasing amplitude, then with a sudden diminution followed by another gradual increase. The observations have not been sufficiently continuous or extended to decide whether this variation in amplitude is periodic, and in any case the very small range combined with the comparatively poor quality of the spectrum for measurement would render such a determination difficult and uncertain even if a very large number of plates were obtained.

I have, therefore, thought it preferable now, as all these successive curves have, so far as can be determined, the same form, to consider the variations in amplitude as accidental or, if you like, as due to errors in measurement; and to obtain a mean curve and from it the elements of the orbit by grouping together into normal places the mean velocities obtained on the 54 nights under discussion. The period chosen was that mentioned above, 21.90 days, which best suited our own and the Lick observations and which under the conditions cannot probably be improved upon. The initial phase  $T_0$  was taken as Julian day 2,417,961.0. The basis of grouping into the normal places was the phase, the total difference in phase in the nights in a group being kept generally less than half a day, except in three groups where the velocity changes but slowly.

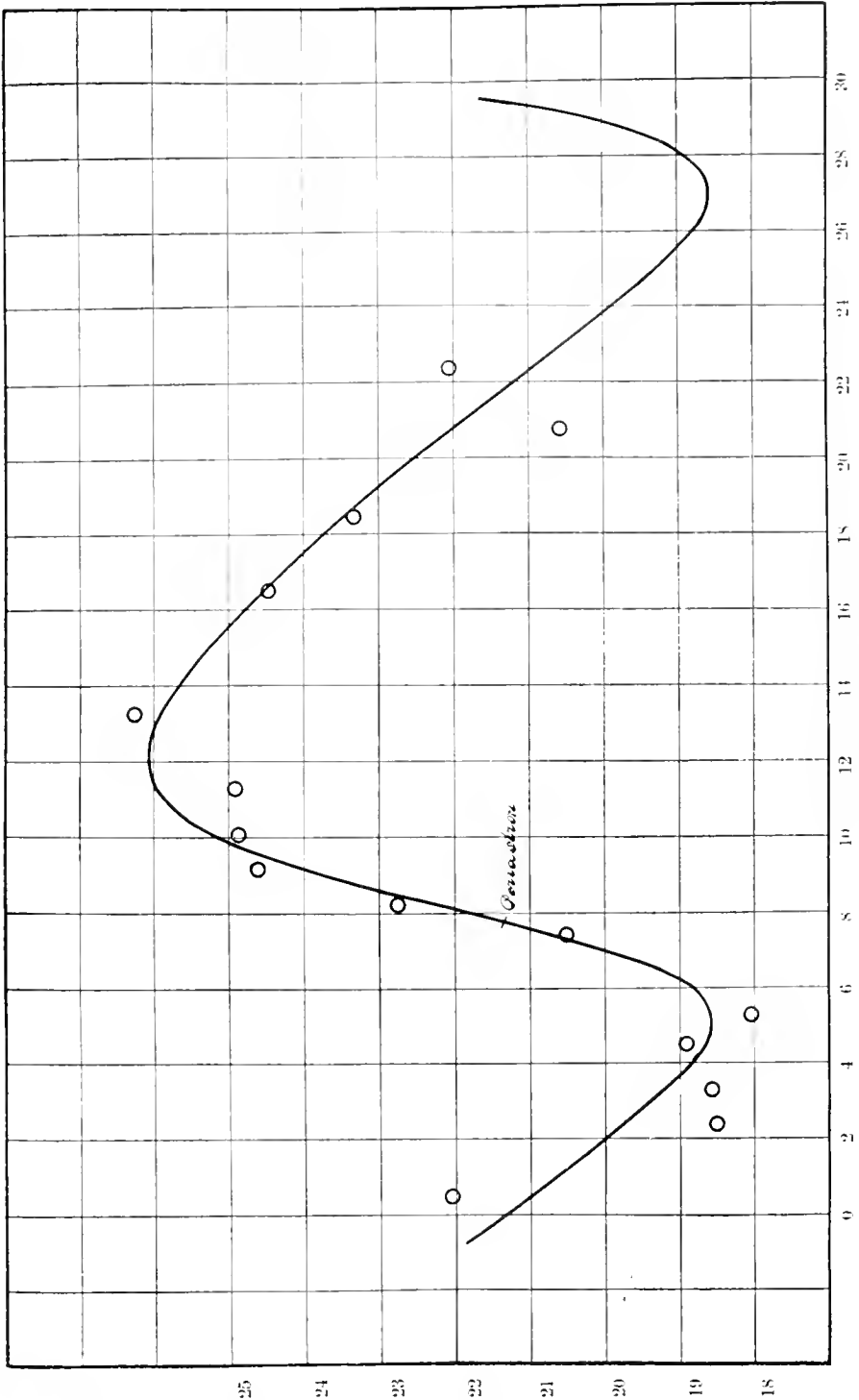


FIG. 16—Velocity Curve of  $\beta$  Orionis.



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These normal places with other data are given in the table below, and the places themselves are indicated by circles on the velocity curve Fig. (16) corresponding to the final elements.

NORMAL PLACES  $\beta$  ORIONIS.

| No. | Mean velocity. | Mean phase. | No. of nights. | No. of plates. | Total diff. of phase. | Weight. | Weight used in solution. | Residual O C |
|-----|----------------|-------------|----------------|----------------|-----------------------|---------|--------------------------|--------------|
| 1   | 22.06          | 0.444       | 3              | 35             | 0.48                  | 17      | 1                        | -1.02        |
| 2   | 18.51          | 2.350       | 3              | 15             | 0.24                  | 9       | 1                        | -1.24        |
| 3   | 18.59          | 3.266       | 3              | 14             | 0.15                  | 7       | 1                        | -0.60        |
| 4   | 18.92          | 4.481       | 5              | 22             | 0.59                  | 17      | 1                        | -0.27        |
| 5   | 18.06          | 5.240       | 3              | 12             | 0.30                  | 10      | 1                        | -0.47        |
| 6   | 20.51          | 7.427       | 4              | 25             | 0.62                  | 15      | 1                        | -0.10        |
| 7   | 22.76          | 8.200       | 2              | 10             | 0.27                  | 5       | 1                        | -0.61        |
| 8   | 24.63          | 9.160       | 4              | 16             | 0.63                  | 11      | 1                        | -0.65        |
| 9   | 24.90          | 10.024      | 4              | 10             | 0.46                  | 7       | 1                        | -0.26        |
| 10  | 24.91          | 11.265      | 6              | 31             | 1.66                  | 16      | 1                        | -1.10        |
| 11  | 26.28          | 13.253      | 10             | 39             | 1.81                  | 23      | 1                        | -0.34        |
| 12  | 24.49          | 16.567      | 3              | 22             | 1.52                  | 12      | 1                        | -0.05        |
| 13  | 23.34          | 18.431      | 3              | 10             | 0.67                  | 8       | 1                        | 0.17         |
| 14  | 20.60          | 20.740      | 1              | 12             | 0.00                  | 6       | 1                        | -1.48        |

With these normal places and by the graphical method developed by you, described in last year's report, the elements given below were readily determined, with which the observations seemed to agree closely. However, owing to the considerable differences in the weight of the normal places, which could not very well be allowed for in a graphical solution, and to the advantages demonstrated by previous experience, it was felt desirable to apply a least squares correction to these elements.

For coefficients of the corrections the equations developed by Lehmann-Filhés\* were used, and from these and from the ephemeris obtained from the normal places and preliminary elements, the following observation equations were derived. All of the elements except the period, which was considered as closely determined as possible from the range of velocity present and the short interval used, were included in this solution and an unknown of coefficient unity for the velocity of the system was added.

OBSERVATION EQUATIONS  $\beta$  ORIONIS.

| $x$            | $y$        | $z$             | $u$               | $v$   | $W$   | Weight. | $s$    |
|----------------|------------|-----------------|-------------------|---|-------|---------|--------|
| $\delta\gamma$ | $\delta K$ | $K\delta\omega$ | $K\delta\epsilon$ | $\frac{K\mu\delta T}{(1-\epsilon^2)^{\frac{3}{2}}}$ | $V$   |         |        |
| 1.000          | -0.505     | -0.698          | -0.892            | +0.892  | -1.51 | 1       | +0.071 |
| "              | -0.851     | -0.408          | -0.859            | -0.601  | -0.74 | 1       | -1.937 |
| "              | -0.975     | -0.190          | -0.523            | +0.384  | -0.20 | 1       | -0.942 |
| "              | -1.052     | +0.178          | -0.223            | -0.015  | -0.42 | 1       | -0.507 |
| "              | -1.020     | +0.443          | -0.528            | -0.249  | +0.56 | 1       | -0.206 |
| "              | -0.464     | +1.104          | -0.598            | -0.911  | +0.19 | 1       | -0.325 |
| "              | -0.138     | +1.189          | -0.140            | -0.996  | -0.83 | 1       | +0.365 |
| "              | -0.267     | +1.141          | -0.924            | -0.948  | -1.18 | 1       | +1.204 |
| "              | -0.569     | +0.977          | -0.845            | -0.784  | -0.33 | 1       | -2.277 |
| "              | +0.876     | -0.565          | -0.519            | -0.372  | +0.80 | 1       | +3.388 |
| "              | +0.941     | +0.071          | -0.486            | -0.122  | -0.31 | 1       | -1.338 |
| "              | +0.588     | -0.575          | -0.869            | -0.774  | +0.16 | 1       | -1.078 |
| "              | -0.267     | -0.755          | -1.366            | +0.948  | -0.10 | 1       | -0.194 |
| "              | -0.183     | -0.798          | -0.460            | -0.991  | +1.16 | 1       | -2.630 |

\* A. N., No. 3242.

From these observation equations the following normal equations were obtained:—

$$\begin{aligned}
 &6\ 833x - 0\ 558y + 1\ 110z - 0\ 041u - 0\ 213v - 1\ 132=0 \\
 &- 0\ 558x + 3\ 735y + 0\ 085z - 0\ 466u - 0\ 192v - 0\ 185=0 \\
 &- 1\ 110x + 0\ 085y + 3\ 284z + 0\ 192u - 3\ 072v - 0\ 211=0 \\
 &- 0\ 041x - 0\ 466y + 0\ 192z + 3\ 363u - 0\ 202v - 1\ 192=0 \\
 &+ 0\ 213x - 0\ 192y - 3\ 072z - 0\ 202u + 3\ 118v - 0\ 009=0
 \end{aligned}$$

From the elimination there resulted the following values of the unknowns with their probable errors:—

$$\begin{aligned}
 x \text{ or } \delta\gamma &= +\ 1721 & \pm\ 1584 \\
 y \text{ or } \delta K &= +\ 0212 & \pm\ 2096 \\
 z \text{ or } K\delta\omega &= -\ 0157 & \delta\omega = -\ 0042 = -\ 0\ 24'' \pm\ 3\ 48'' \\
 u \text{ or } K\delta e &= -\ 3604 & \delta e = +\ 0061 \pm\ 0587 \\
 & & K\ \mu\ \delta\ T \\
 v \text{ or } \frac{(1-e^2)^{3/2}}{a} &= 0 & \delta T = 0
 \end{aligned}$$

When these are applied to the preliminary values we obtain:

ELEMENTS OF  $\beta$  ORIONIS.

| Name.                        | Symbol.    | Preliminary. | Corrected.                                  |
|------------------------------|------------|--------------|---|
| Eccentricity.....            | $\epsilon$ | 0 20         | 0 296 $\pm$ 059                             |
| Half-Amplitude.....          | $K$        | 3 75         | 3 771 $\pm$ 210 km.                         |
| Longitude of Apse.....       | $\omega$   | 255          | 254 <sup>o</sup> 76 $\pm$ 3 <sup>o</sup> 48 |
| Periastron Passage.....      | $T$        | 7 80         | J. D. 2 417,968 80                          |
| Period.....                  | $U$        | 21 90        | 21 90 dys.                                  |
| Velocity of System.....      | $\gamma$   | -22 444      | +22 616 $\pm$ 158 km.                       |
| Projection of Semi axis..... | $a \sin i$ | 1,100,500    | 1,108,900 km.                               |
| Maximum Velocity.....        | $N_1$      | -26 0        | -26 09 km.                                  |
| Minimum Velocity.....        | $N_2$      | -18 5        | -18 55 km.                                  |

It will be noticed that except for the eccentricity the changes in the elements are very small and a comparison between the residuals from the corrected ephemeris and from substitution in the observation equations shows that the solution is satisfactory enough, as there are none greater than .25km. It was not deemed necessary to make a second solution considering the assumptions made in combining the observations. That the solution has improved the elements was shown at once on comparing the curves and is also evident by the reduction of  $\Sigma pvr$  from 3.85 to 3.16.

The probable error of a normal place of unit weight is  $\pm$  0.40km. The probable error of a night obtained by scaling from the curve is  $\pm$  1.50. The probable error of a plate obtained with a dispersion of three prisms is  $\pm$  1.98km., with dispersion of one prism  $\pm$  3.22km., and including all the plates  $\pm$  2.62km. If, as was done, the observations are divided into two sets—those before and those after January 29, 1909, when the sudden change in amplitude was noticed—and separate curves and elements are obtained roughly for these sets, the probable error of a night reduces to  $\pm$  1.37km. with a proportional reduction in the probable errors of single plates, and this would probably be not much greater than 1km. if the amplitude remained constant. For the two sets mentioned above, it may be of interest to compare the maximum and minimum velocities. Those of the first set are + 17 and + 29 and of the second + 19 and + 23.5.

This solution must, however, owing to the peculiar behaviour of the star, be regarded as preliminary only. It is only when many more observations have been secured and the star has been closely followed for some time that any more definite idea of the nature of the changes taking place may possibly be obtained, and it is proposed in the future to follow it as closely as the other work on hand will permit.

I have the honour to be, sir,

Your obedient servant,

J. S. PLASKETT.

## APPENDIX A.

ORBITS OF  $\theta$  AQUILE,  $\epsilon$  HERCULIS, AND  $\eta$  BOÖTIS.

W. E. HARPER.

THE ORBIT OF  $\theta$  AQUILE.

The star  $\theta$  Aquile ( $\alpha = 20^{\text{h}} 06^{\text{m}}.2$ ,  $\delta = -1^{\circ} 07'$ , photographic magnitude 3.6) was discovered to be a spectroscopic binary by M. Deslandres\* in 1902. From the twenty-six plates secured he obtained a period of 16.7 days and eccentricity about 0.6. As the results obtained by him were regarded as only provisional, the star was placed on our observing list here in May, 1907, when the single-prism spectrograph was ready for use. In all forty-five measurable plates were secured that year and from these, preliminary values of the elements were obtained.† For convenience of reference these are given here:

$$P = 17.17^{\text{d}}$$

$$\gamma = -26.7^{\text{km}}$$

$$e = 0.725$$

$$\omega = 20^{\circ}$$

$$T = 1907, \text{ Oct. } 2.15 \text{ G.M.T.}$$

$$= \text{J. D. } 2,417,851.15$$

$$a \sin i = 8.455,500^{\text{km}}$$

As unfavourable weather prevented the securing of spectrograms in all its phases, particularly near the time of periastron passage, work was resumed on it this year with the object of filling up any gaps in the curve. Fifty-two spectrograms were secured this year and these have been combined with those of last year to determine the orbit. Some half-dozen plates of last year in which the agreement among the various lines was not all that could be desired were remeasured, but only two, Nos. 924 and 959, were changed in velocity appreciably. Plates 1038 and 1050 which had not been measured last year are also added.

Four of the plates (Nos. 1001, 1100, 1101 and 1794) were made with the three-prism spectrograph, whose linear dispersion at  $H\gamma$  is 10.1 tenth-metres per millimetre. The balance were all made with the single-prism spectrograph which at  $H\gamma$  has a linear dispersion of 30.2 tenth-metres per millimetre and gives the whole visible spectrum in sharp focus. The region used for velocity determinations is that lying between and including  $H\beta$  and  $K$ . The plates used were Seed 27.

The spectrum is of the type VIIa, and in the portion used the  $Mg$  line ( $\lambda$  4481) and  $K$  ( $\lambda$  3933) are best defined. The hydrogen lines are fairly well measurable, especially  $H\gamma$ , the line  $\lambda$  4549 is fairly sharp as are also the silicon lines. In addition to those given in Table I, some faint metallic lines also appear in some of the plates. The velocities corresponding to one revolution of the micrometer screw (0.5mm. pitch) are also attached.

\* Bulletin Astronomique XX., 129, 1903.

† Journal of the Royal Astronomical Society of Canada I., 357, 1907.

TABLE I.  
LINES IN  $\theta$  AQUILE.

| Element. | Wave-Length. | Velocity<br>per<br>Revolution. |
|----------|--------------|--------------------------------|
| H.....   | 4861.527     | 1451                           |
| Fr.....  | 4549.642     | 1204                           |
| Mg.....  | 4481.400     | 1151                           |
| H.....   | 4340.634     | 1044                           |
| Fe.....  | 4233.328     | 961                            |
| He.....  | 4143.928     | 898                            |
| Si.....  | 4131.047     | 889                            |
| St.....  | 4128.211     | 887                            |
| H.....   | 4101.890     | 868                            |
| H.....   | 3970.177     | 774                            |
| Ca.....  | 3933.825     | 749                            |

Practically all the plates made have been used in the discussion, even although one or two have not been of the best quality, No. 865 being a case in point. In the preliminary curve for this year ( $P=17.120$ ) No. 873 gave an abnormally high residual ( $-28$ km.) and following out a suggestion of Mr. J. S. Plaskett, to whom I am much indebted for help during this work, the result was omitted from consideration in the least-square solution, as an excessive residual tends to distort the elements out of all agreement with the mean values, as obtained from the remaining observations.

The following table gives all the data of the plates, the phase being reckoned from periastron, Julian Day 2,417,731.504, using the period finally determined, 17.112 days.

TABLE II.  
MEASURES OF  $\theta$  AQUILE.

| Plate No. | Julian Date.  | Phase. | No. of<br>lines. | Wt. | Velocity. | Residual. |
|-----------|---------------|--------|------------------|-----|-----------|-----------|
| 1907.     |               |        |                  |     |           |           |
| 803.....  | 2,417,727.814 | 13.425 | 4                | 5   | - 24      | - 0.2     |
| 819.....  | 737.787       | 6.284  | 4                | 5   | - 39      | + 3.1     |
| 841.....  | 739.836       | 8.333  | 4                | 5   | - 38      | - 0.4     |
| 854.....  | 741.813       | 10.310 | 4                | 5   | - 42      | - 5.9     |
| 865.....  | 747.778       | 16.275 | 1                | 2   | + 45      | +16.0     |
| 905.....  | 759.777       | 11.162 | 5                | 4   | - 40      | - 5.2     |
| 924.....  | 765.777       | 0.050  | 5                | 4   | + 30      | -19.5     |
| 931.....  | 766.711       | 0.984  | 7                | 5   | - 30      | + 9.8     |
| 942.....  | 770.703       | 4.976  | 4                | 4   | - 40      | + 5.7     |
| 946.....  | 773.713       | 7.986  | 3                | 3   | - 43      | - 5.0     |
| 959.....  | 777.764       | 12.037 | 5                | 3   | - 40      | - 7.8     |
| 969.....  | 784.760       | 1.921  | 4                | 4   | - 40      | - 1.8     |
| 1001..... | 798.660       | 15.821 | 5                | 4   | + 19      | + 6.2     |
| 1012..... | 801.692       | 1.741  | 4                | 3   | - 39      | - 2.0     |
| 1013..... | 803.573       | 3.622  | 6                | 4   | - 51      | - 4.1     |
| 1027..... | 815.630       | 15.679 | 3                | 3   | + 10      | + 1.1     |
| 1028..... | 815.669       | 15.718 | 2                | 5   | + 11      | + 1.0     |
| 1033..... | 825.612       | 8.519  | 4                | 3   | - 38      | - 0.6     |
| 1038..... | 831.635       | 14.572 | 4                | 2   | - 8       | + 3.6     |
| 1043..... | 833.673       | 16.610 | 7                | 3   | + 55      | +10.5     |
| 1050..... | 837.614       | 3.438  | 4                | 4   | - 47      | - 0.4     |
| 1072..... | 849.543       | 15.367 | 5                | 4   | + 3       | + 1.3     |
| 1073..... | 849.559       | 15.383 | 4                | 5   | + 4       | + 2.1     |
| 1074..... | 849.589       | 15.413 | 6                | 5   | - 7       | - 9.4     |
| 1080..... | 850.502       | 16.326 | 3                | 2   | + 28      | - 2.6     |
| 1081..... | 850.521       | 16.345 | 5                | 3   | + 33      | + 0.8     |
| 1082..... | 850.548       | 16.372 | 6                | 4   | + 30      | - 3.8     |
| 1085..... | 850.613       | 16.437 | 8                | 5   | + 25      | -10.5     |
| 1086..... | 850.642       | 16.466 | 5                | 3   | + 36      | - 1.0     |
| 1089..... | 851.528       | 0.240  | 5                | 4   | + 18      | -12.0     |
| 1091..... | 851.570       | 0.282  | 3                | 2   | + 28      | + 0.2     |
| 1092..... | 851.589       | 0.301  | 5                | 2   | - 23      | - 2.6     |



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TABLE II.  
MEASURES OF  $\theta$  AQUILA. -Continued.

| Plate No. | Julian Date.  | Phase. | No. of lines. | Wt. | Velocity. | Residual. |
|-----------|---------------|--------|---------------|-----|-----------|-----------|
| 1907.     |               |        |               |     |           |           |
| 1093..... | 2,417,851.665 | 0 317  | 5             | 3   | + 26      | + 2.6     |
| 1094..... | 851.625       | 0 337  | 2             | 1   | + 12      | - 9.0     |
| 1100..... | 867.510       | 16 223 | 1             | 1   | + 28      | + 1.7     |
| 1101..... | 867.574       | 16 287 | 3             | 3   | + 33      | + 4.0     |
| 1106..... | 874.535       | 6 135  | 4             | 2   | - 44      | + 1.4     |
| 1128..... | 884.437       | 16 038 | 5             | 5   | + 16      | - 4.0     |
| 1129..... | 884.452       | 16 052 | 5             | 5   | + 32      | + 11.6    |
| 1146..... | 896.500       | 10 988 | 1             | 2   | - 35      | - 2.8     |
| 1149..... | 898.448       | 12 936 | 3             | 1   | - 31      | - 3.4     |
| 1150..... | 898.526       | 13 014 | 5             | 3   | - 20      | + 7.2     |
| 1154..... | 899.445       | 13 933 | 4             | 3   | - 18      | + 1.8     |
| 1155..... | 899.458       | 13 946 | 3             | 2   | - 30      | - 10.0    |
| 1157..... | 903.529       | 0 905  | 3             | 3   | - 33      | + 3.9     |
| 1908.     |               |        |               |     |           |           |
| 1533..... | 2,418,077.871 | 4 126  | 5             | 3   | - 50      | - 3.0     |
| 1544..... | 089.873       | 7 128  | 2             | 2   | - 37      | + 3.0     |
| 1576..... | 096.857       | 6 000  | 3             | 3   | 48        | - 5.0     |
| 1583..... | 098.821       | 7 964  | 5             | 3   | - 31      | + 7.0     |
| 1604..... | 105.814       | 11 943 | 7             | 3   | - 11      | - 5.0     |
| 1605..... | 105.843       | 15 000 | 6             | 3   | - 15      | - 10.0    |
| 1626..... | 115.774       | 7 805  | 7             | 4   | - 29      | + 9.3     |
| 1634..... | 117.824       | 9 855  | 7             | 5   | - 29      | + 7.5     |
| 1643..... | 119.821       | 11 852 | 6             | 5   | - 30      | + 3.0     |
| 1651..... | 120.781       | 12 812 | 9             | 5   | - 32      | - 4.0     |
| 1659..... | 126.729       | 1 648  | 2             | 2   | - 36      | - 0.5     |
| 1679..... | 131.785       | 6 704  | 5             | 3   | - 39      | + 2.0     |
| 1691..... | 133.812       | 8 731  | 5             | 3   | - 41      | - 4.0     |
| 1696..... | 134.799       | 9 718  | 5             | 4   | - 34      | + 2.5     |
| 1704..... | 136.818       | 11 737 | 6             | 2   | - 33      | $\pm$ 0.0 |
| 1708..... | 137.764       | 12 683 | 5             | 4   | - 26      | + 3.3     |
| 1716..... | 138.809       | 13 728 | 7             | 5   | - 19      | + 2.5     |
| 1727..... | 148.687       | 6 494  | 5             | 5   | - 37      | + 4.6     |
| 1730..... | 149.735       | 7 512  | 5             | 4   | - 39      | $\pm$ 0.0 |
| 1731..... | 149.755       | 7 562  | 5             | 3   | - 41      | - 2.2     |
| 1732..... | 150.769       | 8 597  | 5             | 3   | - 33      | + 4.3     |
| 1733..... | 150.840       | 8 617  | 2             | 2   | - 41      | - 3.8     |
| 1735..... | 151.743       | 9 551  | 6             | 3   | - 43      | - 6.5     |
| 1736..... | 151.756       | 9 564  | 2             | 1   | - 30      | + 6.5     |
| 1747..... | 153.740       | 11 547 | 5             | 3   | - 31      | + 3.0     |
| 1755..... | 154.744       | 12 551 | 5             | 2   | 31        | - 1.0     |
| 1756..... | 154.764       | 12 571 | 5             | 3   | - 26      | + 4.0     |
| 1762..... | 159.619       | 0 316  | 7             | 3   | - 35      | + 10.0    |
| 1766..... | 159.687       | 0 384  | 4             | 3   | - 33      | + 13.0    |
| 1767..... | 159.722       | 0 419  | 5             | 3   | - 16      | + 3.0     |
| 1769..... | 159.784       | 0 481  | 3             | 2   | $\pm$ 0   | - 8.0     |
| 1776..... | 161.708       | 2 395  | 4             | 2   | - 41      | + 1.5     |
| 1777..... | 161.740       | 2 443  | 7             | 4   | - 39      | + 4.0     |
| 1789..... | 171.763       | 12 458 | 5             | 3   | - 21      | + 9.0     |
| 1794..... | 173.697       | 14 392 | 5             | 3   | - 24      | - 10.0    |
| 1799..... | 174.635       | 15 328 | 8             | 2   | $\pm$ 0   | - 1.0     |
| 1800..... | 174.658       | 15 351 | 6             | 2   | - 2       | - 3.0     |
| 1801..... | 174.695       | 15 398 | 6             | 3   | + 7       | + 4.5     |
| 1807..... | 175.581       | 16 273 | 6             | 2   | + 29      | + 1.0     |
| 1808..... | 175.605       | 16 297 | 7             | 2   | + 26      | - 3.0     |
| 1810..... | 175.645       | 16 337 | 5             | 2   | + 22      | - 10.0    |
| 1811..... | 176.645       | 0 228  | 5             | 3   | + 35      | + 4.0     |
| 1812..... | 176.664       | 0 247  | 5             | 1   | + 39      | + 10.0    |
| 1813..... | 176.681       | 0 264  | 7             | 2   | - 35      | + 6.0     |
| 1814..... | 177.659       | 1 242  | 6             | 4   | - 30      | - 1.5     |
| 1815..... | 177.680       | 1 263  | 8             | 4   | - 33      | - 4.0     |
| 1822..... | 178.702       | 2 285  | 7             | 5   | 35        | + 7.0     |
| 1835..... | 181.584       | 5 165  | 5             | 4   | - 49      | - 3.0     |
| 1864..... | 188.678       | 12 259 | 8             | 5   | - 33      | - 1.7     |
| 1875..... | 193.529       | 0 000  | 5             | 4   | - 51      | - 2.6     |
| 1876..... | 193.570       | 0 040  | 5             | 4   | - 51      | + 1.0     |
| 1878..... | 2,418,196.625 | 3 094  | 5             | 4   | - 48      | - 2.0     |

The observations of 1907 and 1908 were grouped separately and the period which suited best was 17.120 days. The phases for this period were computed, being reckoned from an initial epoch  $T_0$ , Julian Day 2,417,727, the date of the first observation. The observations of the two years were now combined and grouped into 18 normal places. Weights were assigned to these groups depending not only upon the sum of the weights of the individual plates, but upon the number of nights involved. The maximum weight was taken as 5. In the weighting of the individual plates, not only the quality of the plate *per se*, but the agreement among the various lines was taken into account. The groups are given in Table III.

TABLE III.  
NORMAL PLACES.

| Mean Phase. | Mean Velocity. | Wt. | Mean Phase. | Mean Velocity. | Wt. |
|-------------|----------------|-----|-------------|----------------|-----|
| 1 09        | -22 3          | 3   | 5 49        | -31 3          | 2   |
| 2 13        | -11 7          | 1   | 6 47        | -38 2          | 3   |
| 2 66        | - 0 7          | 3   | 7 96        | -48 9          | 2   |
| 3 09        | -13 3          | 1   | 9 46        | -44 5          | 1   |
| 3 42        | -24 9          | 2   | 10 73       | -40 5          | 2   |
| 3 72        | -34 3          | 3   | 12 05       | -36 4          | 2   |
| 4 31        | +51 0          | 1   | 13 93       | -37 4          | 5   |
| 4 54        | -33 6          | 1   | 16 28       | -33 0          | 2   |
| 4 72        | +22 5          | 3   | 17 05       | -26 7          | 3   |

Using the graphical method\* of Dr. King, various values of  $e$  and  $\omega$  were tried, those finally decided upon as suiting the grouped observations best being  $e = .680$ ,  $\omega = 20^\circ$ ,  $K = 49\text{km.}$  and time of periastron passage,  $T$ , 4.30 days from initial epoch. Thus for preliminary elements we have:

- $P = 17.120$  days
- $e = 0.680$
- $\omega = 20^\circ$
- $T = \text{Julian Day } 2,417,731.30$
- $K = 49\text{km.}$
- $\gamma = -25.3\text{km.}$

With these elements it was decided to make a least-square solution for the normal places. Using the differential equation of Lehmann-Filhés†

$$\delta \left( \frac{dz}{dt} \right) = \delta \gamma + (\cos u + e \cos \omega) \delta K + \left[ \cos \omega - \frac{\sin u \sin v}{1 - e^2} \cdot (2 + e \cos v) \right] K \delta e$$

$$- [\sin u + e \sin \omega] \cdot K \delta \omega - \sin u (1 + e \cos v)^2 (t - T) \cdot \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \delta \mu$$

$$+ \sin u (1 + e \cos v)^2 \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \mu \cdot \delta T$$

eighteen observation equations were formed, connecting the six unknowns with the residuals between the observed and computed values of the velocity. To make the observation equations homogeneous the following substitutions were made:—

- $x = \delta \gamma$
- $y = \delta K$
- $z = 10,000 \delta \mu$
- $u = 100 \delta e$
- $v = 10 \delta T$
- $w = 10 \delta \omega$

\* Astrophysical Journal, XXVII., 125, 1908.  
† Astronomische Nachrichten 3242.

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There result the following normal equations:—

$$\begin{aligned}
 40.000x + 9.571y - 15.914z - 11.075u + 5.696v + 4.981w + 18.200 &= 0 \\
 + 16.015y - 19.310z - 13.924u + 6.444v + 2.043w - 6.419 &= 0 \\
 + 242.697z + 11.554u - 327.008v + 255.472w + 14.267 &= 0 \\
 + 19.651u - 4.122v + 1.212w - 4.459 &= 0 \\
 + 486.538v - 372.234w - 36.352 &= 0 \\
 + 113.976w - 102.105 &= 0
 \end{aligned}$$

Whence the corrections to the first approximations:

$$\begin{aligned}
 \delta\gamma &= -0.6 \text{ km.} & \delta\rho &= +.011 \\
 \delta K &= +2.1 \text{ km.} & \delta T &= +.134 \text{ days.} \\
 \delta P &= -.004 \text{ days.} & \delta\omega &= 5^{\circ}.27
 \end{aligned}$$

The resulting elements with their probable errors, as determined at a later stage, are:

|                                   |                          |   |                                   |
|-----------------------------------|--------------------------|---|-----------------------------------|
| $P = 17.116 \text{ days}$         | $\pm .008 \text{ days.}$ | } | Final elements (simple solution). |
| $e = 0.691$                       | $\pm .017$               |   |                                   |
| $\omega = 25^{\circ}.27$          | $\pm 2^{\circ}.1$        |   |                                   |
| $T = \text{J. D. } 2,417,731.434$ | $\pm .100 \text{ days.}$ |   |                                   |
| $K = 51.1 \text{ km.}$            | $\pm 3.20 \text{ km.}$   |   |                                   |
| $\gamma = -25.9 \text{ km.}$      | $\pm 0.64$               |   |                                   |
| $A = 83.0 \text{ km.}$            |                          |   |                                   |
| $B = 19.2 \text{ km.}$            |                          |   |                                   |

The residuals from the curve using these corrected values of the elements seemed themselves to lie on a curve, which repeated itself approximately twice during the period of the principal star and having an amplitude of about 8 km. The way the residuals from the observed velocities grouped themselves was not mere chance, there was no doubt that there was some secondary disturbance. The assumption was therefore made that there was a third body whose period was commensurable with the period of the principal star, it going through all its phases in half the time required for that of the principal star. The orbit of the third body was considered circular and the secondary curve taken to cross the primary from above at a time  $T'$ , Julian Day 2,417,732.634. Taking  $K'$  as 4km. and considering  $\theta$  as the angle at any time from  $T'$  the extra terms in the differential equation are:

$$- \sin \theta \delta K' + \frac{2 \pi}{P'} \cdot K' \cdot \cos \theta \cdot \delta T'.$$

Correcting now our values of the computed velocity for each of the eighteen normal places by an amount representing that due to the third body we have a new set of eighteen observation equations connecting the eight unknowns. In these equations, for sake of homogeneity, we put

$$\begin{aligned}
 x &= \delta\gamma \\
 y &= \delta K \\
 z &= \frac{100 K}{(1 - e^2)^{\frac{3}{2}}} \cdot \delta u &= 13525.67 \delta u \\
 u &= K \cdot \delta\rho \\
 v &= \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \mu \cdot \delta T' &= 49.355 \delta T'. \\
 w &= K \cdot \delta\omega \\
 y' &= \delta K' \\
 v' &= \frac{2 \pi}{P'} \cdot K' \cdot \delta T' &= 2.937 \delta T'.
 \end{aligned}$$

There result the following normal equations:—

$$\begin{array}{r}
 10\ 000x \quad + 9\ 394y - 16\ 283z \quad - 22\ 704u + 3\ 111v + 0\ 405w + 7\ 526y' + 3\ 349v' + 33\ 400 = 0 \\
 -15\ 353y - 19\ 924z \quad - 28\ 003u + 3\ 284v + 0\ 016w + 11\ 518y' + 2\ 222v' + 50\ 731 = 0 \\
 \quad + 176\ 184z \quad - 20\ 361u - 62\ 767v + 43\ 949w - 7\ 554y' - 27\ 991v' - 30\ 492 = 0 \\
 \quad \quad + 82\ 772u - 2\ 485v + 0\ 072w - 22\ 165y' - 4\ 273v' - 102\ 683 = 0 \\
 \quad \quad \quad + 24\ 411v - 17\ 105w - 0\ 687y' + 9\ 534v' - 3\ 337 = 0 \\
 \quad \quad \quad \quad + 17\ 037w + 2\ 279y' - 10\ 776v' + 9\ 934 = 0 \\
 \quad \quad \quad \quad \quad + 20\ 463v' + 1\ 950v' + 54\ 416 = 0 \\
 \quad \quad \quad \quad \quad \quad + 19\ 533v' - 1\ 088 = 0
 \end{array}$$

Whence the following corrections are obtained:—

$$\begin{array}{ll}
 \delta\gamma = -0.01 \text{ km.} & \delta T = +0.00 \text{ days.} \\
 \delta K = -1.4 \text{ km.} & \delta\omega = +0^\circ.12 \\
 \delta P = -0.0017 \text{ days.} & \delta K' = -1.3 \text{ km.} \\
 \delta c = +0.007 & \delta T' = +0.159 \text{ days.}
 \end{array}$$

The resulting values of the elements with their probable errors, as determined at a later stage, are:

$$\left. \begin{array}{ll}
 P = 17.114 \text{ days} & \pm 0.008 \text{ days} \\
 e = 0.698 & \pm 0.017 \\
 \omega = 25^\circ.39 & \pm 2^\circ.45 \\
 T = \text{J. D. } 2,417,731.464 & \pm 0.092 \text{ days.} \\
 K = 49.7 \text{ km.} & \pm 3.31 \text{ km.} \\
 \gamma = -25.91 \text{ km.} & \pm 0.66 \text{ km.} \\
 T' = \text{J. D. } 2,417,732.793 & \pm 0.349 \text{ days.} \\
 K' = 2.7 \text{ km.} & \pm 1.02 \text{ km.} \\
 A = 81.04 \text{ km.} \\
 B = 18.36 \text{ km.}
 \end{array} \right\} \begin{array}{l} \text{First approximation (solution} \\ \text{(with secondary oscillation.))} \end{array}$$

The size of the corrections in some of the elements, and the fact that the residuals (computed—observed) as obtained direct were not in all cases in close agreement with those obtained from the differential equation, *i.e.*, by substituting the values of the corrections in the observation equations, made another solution necessary. The values of  $\omega$  and  $\gamma$  were, however, considered established as the corrections were very small and the remaining six unknowns were, with the last elements as the basis, formed anew into eighteen observation equations. In these equations

$$\begin{array}{ll}
 y = \delta K. \\
 z = \frac{100 K}{(1 - e^2)^{\frac{3}{2}}} \delta\mu & = 13534.86 \delta\mu. \\
 u = K \cdot \delta e \\
 v = \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \mu \cdot \delta T' & = 49\ 6906 \delta T'. \\
 y' = \delta K'. \\
 v' = \frac{2\pi}{P} \cdot K' \cdot \delta T'' & = 1.9825 \delta T''.
 \end{array}$$

There result the following normal equations:—

$$\begin{array}{l}
 14.733y - 19.889z - 28.221u + 3.499v + 11.503y' + .938v' + 1.153 = 0 \\
 + 174.454z + 23.938u - 61.517v - 10.663y' - 26.344v' + 17.185 = 0 \\
 + 87.120u - 4.059v - 23.403y' - 2.458v' + 7.668 = 0 \\
 + 23.708v + .794y' + 9.359v' - 9.616 = 0 \\
 + 21.411y' + 1.290v' + 1.868 = 0 \\
 + 18.581v' - 4.992 = 0
 \end{array}$$

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Whence the corrections:

$$\begin{aligned} \delta K &= -0.02 \text{ km.} & \delta T &= +0.039 \text{ days.} \\ \delta P &= -0.0022 \text{ days.} & \delta K' &= -0.05 \text{ km.} \\ \delta e &= +0.0037 & \delta T' &= +0.080 \text{ days.} \end{aligned}$$

The corrected values of the elements with their probable errors, as determined at this stage, are:

|            |                     |       |           |   |   |
|------------|---------------------|-------|-----------|---|---|
| $P =$      | 17.1121 days        | $\pm$ | .005 days | } | Second approximation (solution with secondary oscillation). |
| $e =$      | 0.6943              | $\pm$ | .013      |   |   |
| $\omega =$ | $25^{\circ}.39$     |       |           |   |   |
| $T =$      | J. D. 2,417,731.503 | $\pm$ | .070 days |   |   |
| $K =$      | 49.68 km.           | $\pm$ | 2.28 km.  |   |   |
| $\gamma =$ | - 25.91 km.         |       |           |   |   |
| $T' =$     | J.D. 2,417,732.873  | $\pm$ | .416 days |   |   |
| $K' =$     | 2.65 km.            | $\pm$ | 0.86 km.  |   |   |
| $A =$      | 80.84 km.           |       |           |   |   |
| $B =$      | 18.52 km.           |       |           |   |   |

This solution should have been sufficient, but when substituting directly in the observation equations and comparing the residuals with those obtained in the ordinary way, there was one fairly large difference 0.40km., two were 0.30km. and the rest varied between 0.0 and 0.2 km. Furthermore, the probable errors of some of the quantities, particularly  $K$ , seemed too large. It was decided then to compute the probable errors corresponding to the previous corrections made. They are collected in the accompanying Table IV.:-

TABLE IV.

SUMMARY OF CORRECTIONS.

| Elements.           | Preliminary Values. | First Corrected Values.          | Second Corrected Values.          | Third Corrected Values.  |
|---------------------|---------------------|----------------------------------|-----------------------------------|--------------------------|
| $P$ .....           | 17.120 d            | 17.116 d $\pm$ .008              | 17.114 d $\pm$ .008               | 17.112 d $\pm$ .005      |
| $e$ .....           | 0.680               | 0.691 $\pm$ .017                 | 0.698 $\pm$ .017                  | 0.6943 $\pm$ .013        |
| $\omega$ .....      | $20^{\circ}$        | $25^{\circ} 27' \pm 2^{\circ}.1$ | $25^{\circ} 39' \pm 2^{\circ}.45$ |                          |
| $T$ .....           | J. D. 2417731.30    | ...731.434 $\pm$ 100             | ...731.464 $\pm$ .092             | ...731.503 $\pm$ .070    |
| $K$ .....           | 49.0 km.            | 51.1 km. $\pm$ 3.20 km.          | 49.7 km. $\pm$ 3.31 km.           | 49.68 km. $\pm$ 2.28 km. |
| $\gamma$ .....      | 25.3 km.            | - 25.9 km. $\pm$ 0.64 km.        | - 25.91 km. $\pm$ 0.66 km.        |                          |
|                     |                     | Assumed.                         |                                   |                          |
| $T'$ .....          |                     | ( 2417732.634 )                  | ...732.793 $\pm$ .343             | ...732.873 $\pm$ .416    |
| $K'$ .....          |                     | ( 4.0 km. )                      | 2.7 km. $\pm$ 1.92 km.            | 2.65 km. $\pm$ 0.86 km.  |
| $\Sigma prv.$ ..... | 485 km.             | 292 km.                          | 251 km.                           | 235 km.                  |

The values for  $P$ ,  $\gamma$ ,  $T'$  and  $K'$  were now considered determined. The probable errors, especially those in  $K$ , did not seem to be as low as they should be. As the probable error in  $\omega$  in the later determination was larger than in the preceding one, it was thought advisable to take  $e$ ,  $\omega$ ,  $T$  and  $K$  and see if by another solution lower probable errors would be had, and a better agreement between the ephemeris and equation.

As before, for the sake of homogeneity, let

$$\begin{aligned} x &= \delta K \\ y &= K \delta e && = 49.68 \delta e \\ z &= K \delta \omega && = 49.68 \delta \omega \\ u &= \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \mu \delta T = 48.9307 \delta T. \end{aligned}$$

And the resulting normal equations are:

$$\begin{aligned} 14.480x - 28.036y - .077z + 3.931u - 3.236 &= 0 \\ 85.688y + .387z - 3.660u + 4.604 &= 0 \\ 17.243z - 17.072u - 1.533 &= 0 \\ 24.149u + .680 &= 0 \end{aligned}$$

from which corrections result as follows:—

$$\begin{aligned} \delta K &= + 0.29 \text{ km.} \\ \delta e &= + 0.0009 \\ \delta \omega &= + 0^\circ.1743 \\ \delta T &= + 0.0013 \text{ days} \end{aligned}$$

The final elements, taking into account the secondary oscillation, are then as follows. The Allegheny results as discussed later are, for purposes of comparison, given here:—

|              | OTTAWA.   |     | ALLEGHENY.                               |   |
|--------------|---|-----|--|---|
| $P$          | $17.112 \pm .005.$                                  |     | $17.117 \pm .0042$                       | } Final elements (solution with secondary oscillation.) |
| $e$          | $0.695 \pm .010$                                    |     | $0.685 \pm .011$                         |   |
| $\omega$     | $25^\circ.57 \pm 1^\circ.54$                        |     | $17^\circ.53 \pm 1^\circ.58$             |   |
| $T$          | J. D. 2,417,731.504 $\pm .024$                      |     | 1907, Aug. 28, .697 $\pm .034$ dys.      |   |
| $K$          | $49.97 \text{ km.} \pm 1.35 \text{ km.}$            |     | $44.69 \text{ km.} \pm 1.15 \text{ km.}$ |   |
| $\gamma$     | $- 25.91 \text{ km.} \pm 0.66$                      | $-$ | $30.10 \text{ km.}$                      |   |
| $A$          | $81.31 \text{ km.}$                                 |     | $73.88 \text{ km.}$                      |   |
| $B$          | $18.63 \text{ km.}$                                 |     | $15.50 \text{ km.}$                      |   |
| $a \sin i$   | $8,452,100 \text{ km.}$                             |     | $7,665,000 \text{ km.}$                  |   |
| $P'$         | $8.556 \text{ days}$                                |     | $8.558 \text{ days.}$                    |   |
| $T'$         | J.D. 2,417,732.873 $\pm .416$                       |     | 1907, Sept. 9, .176 $\pm .368$ days      |   |
|              | $=$ time when secondary crosses primary from above. |     |  |   |
| $K$          | $2.65 \text{ km.} \pm 0.86$                         |     | $2.39 \text{ km.} \pm 0.77 \text{ km.}$  |   |
| $a' \sin i'$ | $311,800 \text{ km.}$                               |     | $281,000 \text{ km.}$                    |   |

What seems peculiar is that the least-square solution diminished the period in each case, although from a comparison of the 1907 and 1908 observations, when plotted the period would seem to be fixed about 17.120 days. The successive approximations in each case decreased the sum of the squares of the residuals, as seen from Table IV. The final approximation gave  $\Sigma pvr = 238.3 \text{ km.}$ , practically the same as the previous one. The agreement, however, between the equation and ephemeris is much improved, the greatest difference being 0.27 km.; the average 0.15 km. and the probable errors are much lower. Table V. contains the phases for the normal places, reckoned from periastron with the period finally adopted, 17.112 days; the corresponding velocity with its weight, and the residuals as computed directly.

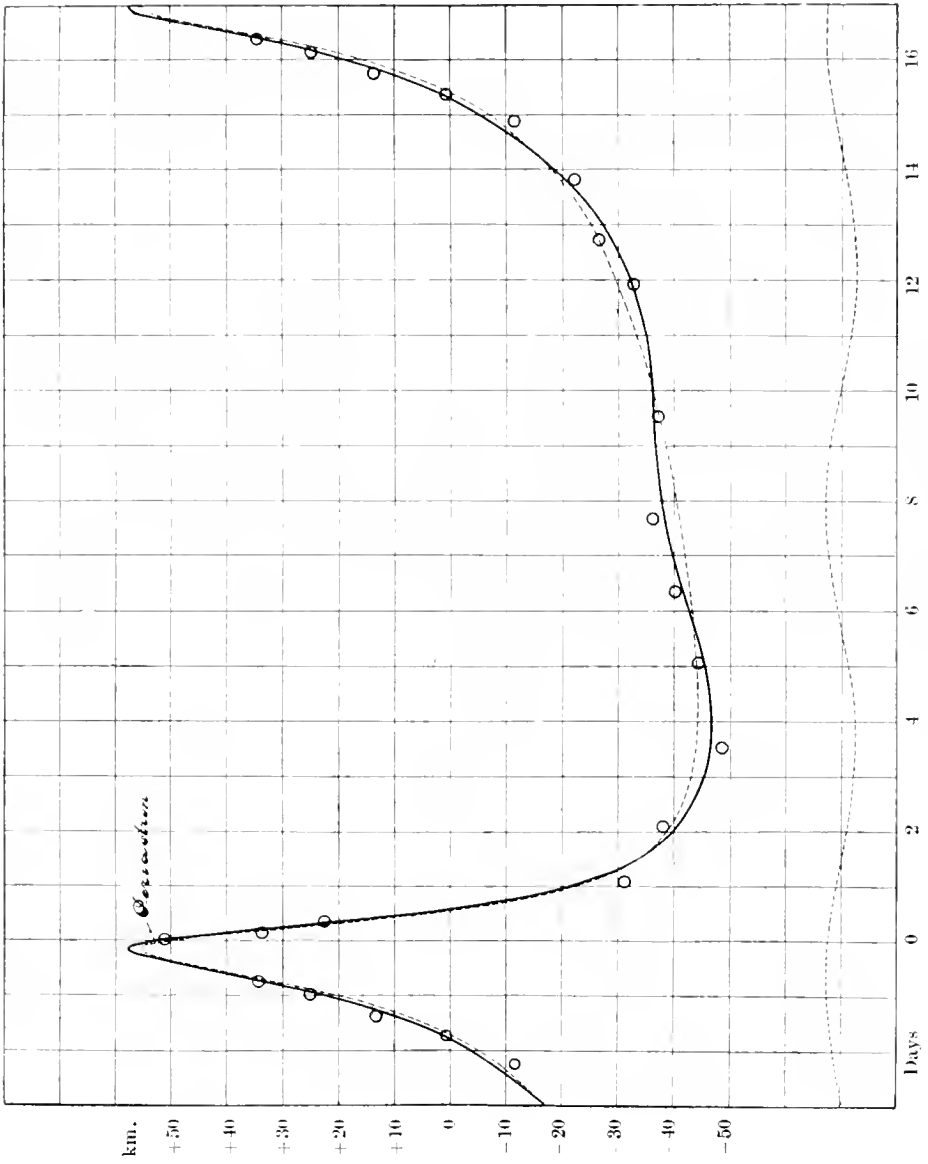


FIG. 17.—Final Velocity Curve of  $\theta$  Aquilae.





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TABLE V.  
NORMAL PLACES.

| No.     | Mean Phase from<br>$T$ | Mean Velocity. | Wt. | Residual-<br>$C - O$ |
|---------|------------------------|----------------|-----|----------------------|
| 1.....  | 13.810                 | -22.33         | 3   | +1.85                |
| 2.....  | 14.871                 | -11.75         | 1   | +4.21                |
| 3.....  | 15.378                 | +0.66          | 3   | +0.85                |
| 4.....  | 15.740                 | +13.33         | 1   | -3.21                |
| 5.....  | 16.143                 | -24.87         | 2   | -1.55                |
| 6.....  | 16.385                 | +34.34         | 3   | -0.44                |
| 7.....  | 0.019                  | +51.00         | 1   | +0.38                |
| 8.....  | 0.166                  | +33.60         | 1   | +4.75                |
| 9.....  | 0.346                  | +22.48         | 3   | -3.03                |
| 10..... | 1.102                  | -31.31         | 2   | +5.95                |
| 11..... | 2.107                  | -38.20         | 3   | -3.16                |
| 12..... | 3.533                  | -48.93         | 2   | +1.93                |
| 13..... | 5.070                  | -44.50         | 1   | -1.17                |
| 14..... | 6.357                  | -40.50         | 2   | -1.53                |
| 15..... | 7.694                  | -36.42         | 2   | -2.39                |
| 16..... | 9.527                  | -37.38         | 5   | +0.36                |
| 17..... | 11.932                 | -33.00         | 2   | +0.07                |
| 18..... | 12.713                 | -26.74         | 3   | -2.31                |

The curve representing the final elements is shown in Fig. 17, the dotted lines being the velocity curves of the primary and secondary components and the heavy continuous line the resultant of these two. The final solution reduces the quantity  $\Sigma prv$  of the residuals for the normal places from 485 to 238.3. The least-square solutions, with the assumption of a secondary disturbance, seem, therefore, to have materially improved the values of the elements. The probable error of a normal place of weight

unity as determined by  $r = \pm .6745 \sqrt{\frac{\Sigma prv}{n - \mu}}$  where  $n$  is the number of normal places

and  $\mu$  the number of unknowns is  $\pm 2.75$ km. The probable error of a plate as derived from the residuals in last column, Table II., which are scaled directly from the curve is for the 1907 observations  $\pm 4.5$ km., and for those of 1908  $\pm 3.5$ km. Grouping the two years together the probable error of a plate is  $\pm 4.0$ km.

#### Previous Observations.

There remains a discussion of M. Deslandres' observations of 1901 and 1902. These were tried in connection with our 1907 observations to determine the period more accurately than could be done by using our own alone. The only period which suits Deslandres' observations alone is the one which he suggests, viz., 16.7 days. If the two observations of 1901 were omitted the other observations will give a better curve when a period of 17.112 days is used. Fig. 18 shows Deslandres' observations using his period of 16.7 days. Fig. 19 shows his 1902 observations using our period of 17.112 days. He suggested an eccentricity of about 0.6; such a value for  $e$  with  $K = 45$  km. and  $\omega = 27^\circ$ , gives a curve represented by the broken line in Fig. 18, while a similar value for  $K$  and  $\omega$ , with an eccentricity 0.4 is represented in the continuous curve and appears to suit the observations as well as, if not better, than the other. The velocities he gives as relative only; I have added 14 km. to each to bring them into agreement with the general run of mine.

As his measures depended upon one line only,  $\lambda 4481$ , and among themselves gave a more or less uncertain determination of the elements, I decided in my preliminary determination to confine myself to our own observations. Now that a definite solution has been secured, it is well to look at them anew. For convenience the data is repro-

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duced here, the tenth of a day being assumed. As stated before, 14km. is added to each velocity determination. The phase with the period 16.7 days is reckoned from the date of first observation of 1902, being Julian Day 2,417,964.4, the phase with the period 17.112 days is reckoned from my own periastron time.

## M. DESLANDRES' OBSERVATIONS.

| Julian Date. | Phase       |              | Velocity. |
|--------------|-------------|--------------|-----------|
|              | $P = 16.7.$ | $P = 17.112$ |           |
| 2,415,568.5  | 4.7         | 10.221       | + 11      |
| 583.5        | 3.0         | 8.109        | + 34      |
| 964.4        | 0.0         | 12.545       | - 2       |
| 969.4        | 5.0         | 0.433        | - 36      |
| 971.4        | 7.0         | 2.433        | - 46      |
| 982.4        | 1.3         | 13.433       | - 6       |
| 989.4        | 8.3         | 3.321        | - 40      |
| 2,416,010.4  | 12.6        | 7.209        | - 39      |
| 011.4        | 13.6        | 8.209        | - 36      |
| 012.4        | 14.6        | 9.209        | - 43      |
| 015.4        | 0.9         | 12.209       | - 25      |
| 020.4        | 5.9         | 0.097        | - 22      |
| 029.3        | 14.8        | 8.997        | - 31(?)   |
| 040.3        | 9.1         | 2.885        | - 46(?)   |
| 047.3        | 16.1        | 0.885        | - 24      |
| 048.3        | 0.4         | 10.885       | - 7       |
| 052.3        | 4.4         | 14.885       | + 39      |
| 054.3        | 6.4         | 16.885       | - 44      |
| 057.3        | 9.4         | 2.773        | - 48      |
| 069.3        | 4.7         | 14.773       | + 10      |
| 071.3        | 6.7         | 16.773       | - 26      |
| 072.3        | 7.7         | 0.661        | - 50      |
| 076.3        | 11.7        | 4.661        | - 47      |
| 086.3        | 5.0         | 14.661       | + 2       |
| 088.3        | 7.0         | 16.661       | - 15      |
| 2,416,095.3  | 14.0        | 6.549        | - 54      |

It is rather hard to say how best to make use of these early observations. Though the measures are liable to accidental errors of considerable magnitude they may, owing to the interval of some six years which has elapsed between the two series of observations, have an important bearing on whether or not any changes in the elements have taken place during that time. Our 1908 observations seemed to be slightly greater positive than the velocities for 1907 for the corresponding phase. This may have been accidental, the difference being at most less than 2 km. If the absolute velocities of Deslandres' observations were known, it would decide whether the velocity of the system has been changing or not during these six years.

If his two observations of the year 1901 are as they appear in his paper, we must conclude that the period has been changing during the interval. If we omit these two and use the remaining twenty-four of 1902 with our elements we get what appears on the face of it to be a much better agreement of the observations with the curve. There is one discrepancy. The observations fall short of the curve by a common amount, 1.5 days. The number of periods elapsed between the two epochs is in round numbers 125. By increasing the period  $\frac{1.5}{125}$  or .012 days, this would be remedied, but while this value of 17.124 days would not make much difference in Deslandres' observations, the least-square solution in our own shows it to be improbable. Here is a suggestion: Is it not probable that the presence of the third body will cause a rotation of the line of apsides similar to that caused by the sun and moon on the earth? A motion of the apse line in the direction of  $\omega$  decreasing and at the uniform rate of  $\frac{.012}{17.112} \times 360^\circ$  or  $0^\circ.2524$  per period would account for this discrepancy. This motion, if it exists,

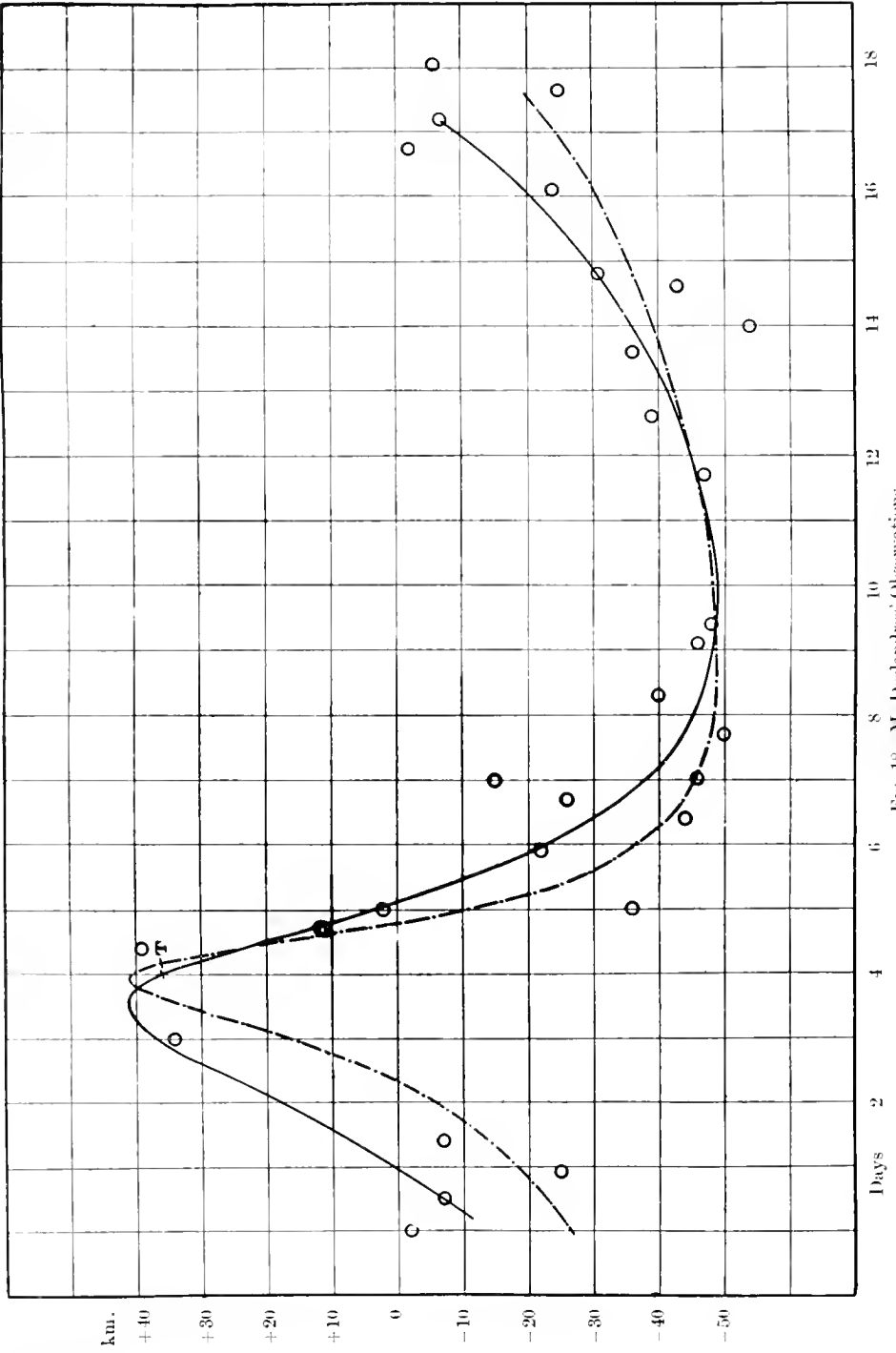


FIG. 18—M. Deslandres' Observations.



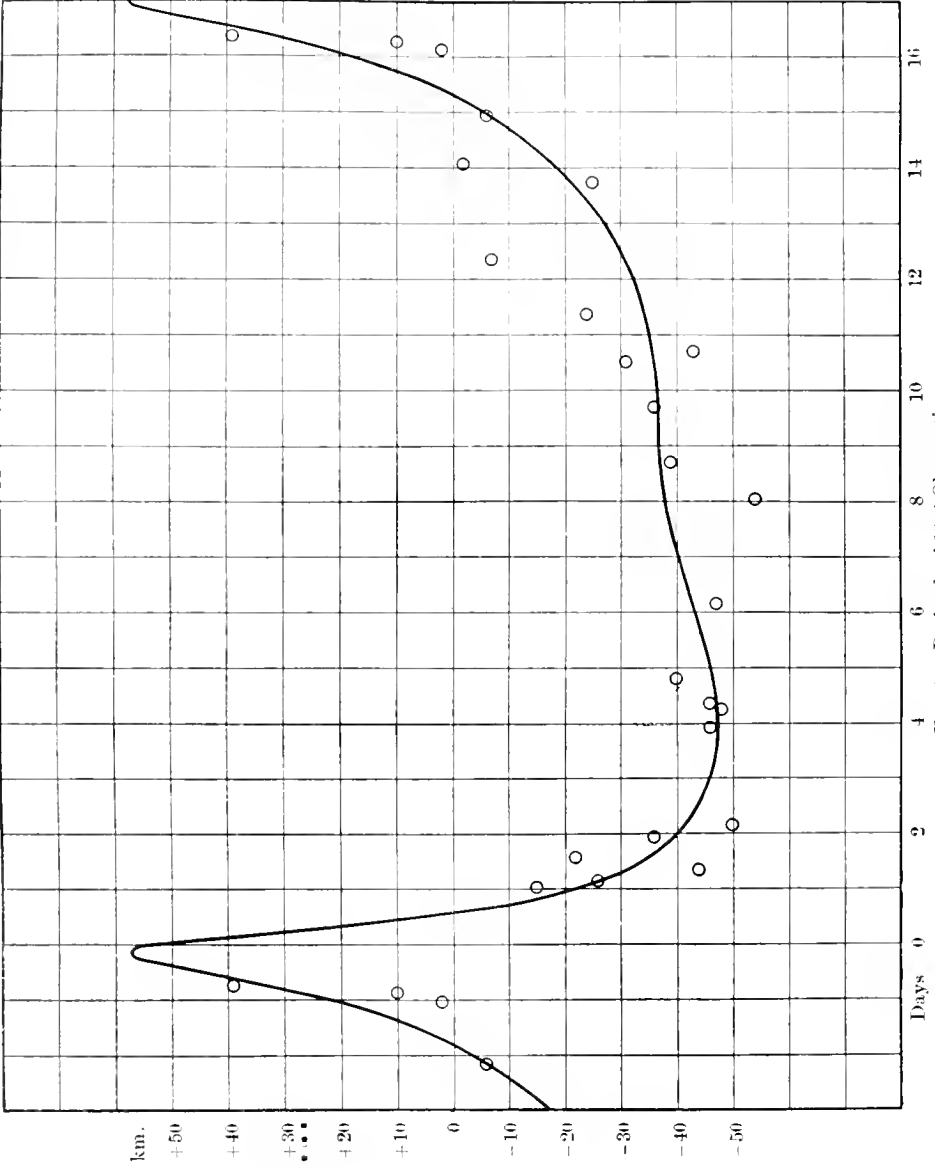


FIG. 19.—Deslandres' 1902 Observations.



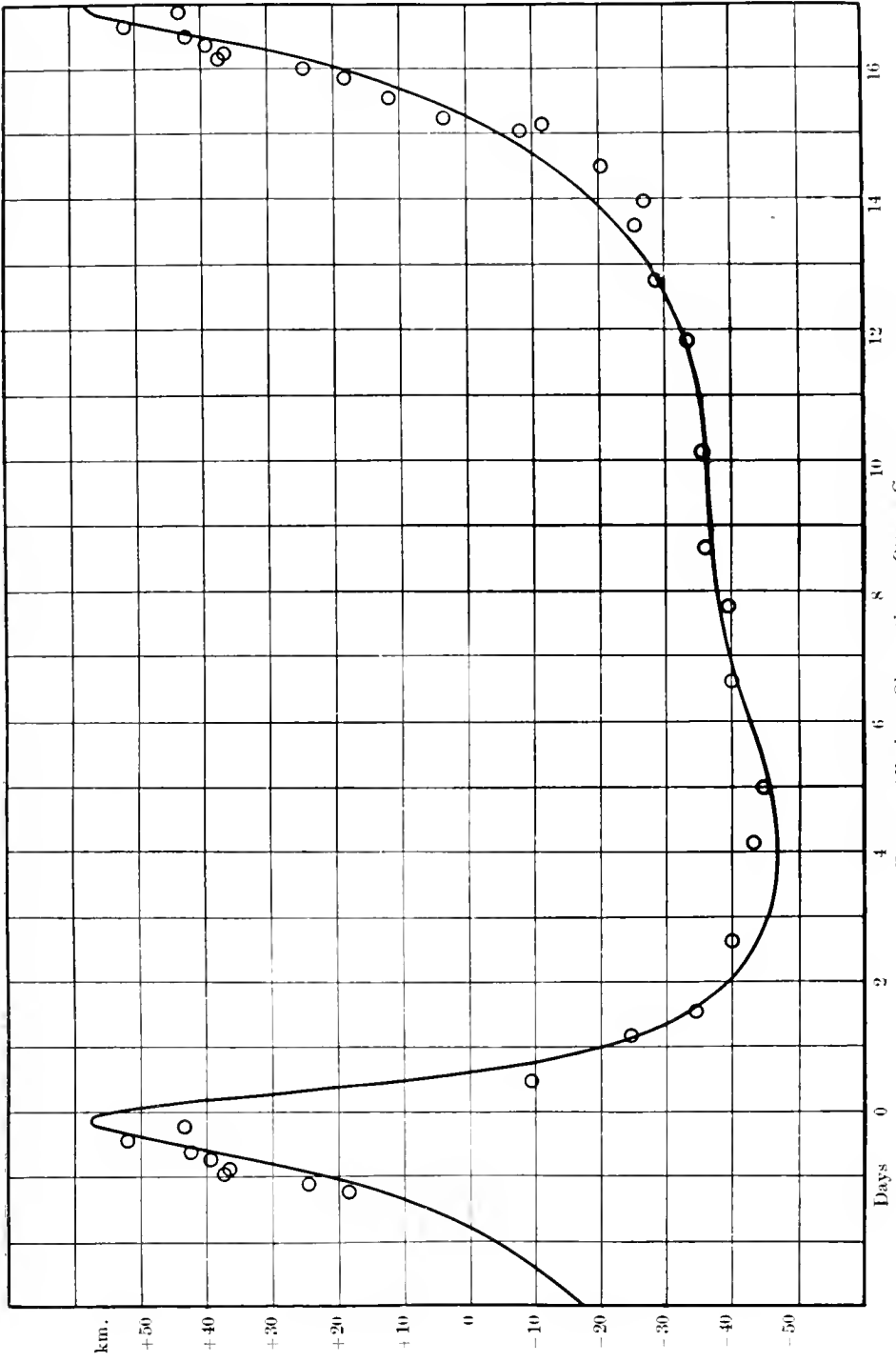


FIG. 20—Allegany Observations. Ottawa Curve.





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would, in addition to decreasing  $\omega$  and consequently the slope of the curve near periastron, also cause the maximum positive velocity to increase and the maximum negative velocity to decrease numerically.

These questions seem to call for further work on the star at some future time. I do not think the data is sufficient at present to make any definite assertion regarding any change in the elements themselves.

*Additional Note on the Allegheny Determination of the Orbit.*

Since the foregoing was completed, No. 7 of Vol. I. of the Publications of the Allegheny Observatory has come to hand, containing the orbit of this same star as determined by Mr. Robert H. Baker. It is possibly the first case where two observers, working with different instruments and entirely independent of each other, have completed a discussion of an orbit at about the same time.

A comparison of the results is interesting. In some cases the agreement is remarkable, for instance the secondary oscillation; in other cases the agreement is not what might be expected. Speaking generally, I may say the reason for the differences exists in the observations themselves, the values Mr. Baker has determined suiting his observations best, while the same may be said of our own. There is a gap in the Allegheny observations near periastron passage. The first normal place, phase 0.16 days, depends upon two plates made the same night, the weights of the plates being about one-half the average weight assigned to a plate. The next normal place falls at phase 0.88 days and depends on two plates made on separate nights. These have relatively low weights also. In this interval of 0.7 days additional observations might, and I feel safe in saying, would tend to change the form of the curve. Our observations for phase 0.16 days depend upon one plate made in 1907 and three made in 1908, the plates being a little below the average weight. We have observations, however, for phase 0.34 days depending upon five plates made in 1907 and four made in 1908, the plates being all of average quality, and it is at this point that additional observations would be an advantage to the Allegheny data.

Looking at the results more in detail we see that Mr. Baker's value for  $\gamma$  is about 4km. more negative than ours. The greater positive velocities secured here, account in a measure for this. There may be an explanation also if the velocity of the system be changing, as suggested previously. The bulk of Allegheny observations were made in 1907, while ours are about equally distributed over 1907 and 1908. There is a minor cause in the assumed wave-lengths of the lines used, causing a systematic difference in the two series of velocities. The wave-lengths given in the first part of my report are those at present universally accepted: those given in Mr. Baker's work are sometimes greater, sometimes less, but on the whole would yield a velocity more negative than would those in use here.

The differences are indicated in the accompanying table:—

| Line.               | Difference in Velocity. | Line.               | Difference in Velocity. |
|---------------------|-------------------------|---------------------|-------------------------|
| $\lambda$ 4549..... | - 0.7 km.               | $\lambda$ 4131..... | - 1.2 km.               |
| 4481.....           | - 0.9 "                 | 4128.....           | - 2.4 "                 |
| 4340.....           | - 1.7 "                 | 3933.....           | - 2.8 "                 |
| 4233.....           | - 6.3 "                 |                     |                         |

On the average a difference of from 1 to 2 km. would be thus accounted for. In certain stars, by examining the trend of the residuals of the various lines and changing their assumed wave-lengths accordingly, a better agreement among the lines themselves can be secured, but unless there are valid reasons therefor it would seem better to retain a constant set of values. Mr. Baker no doubt has good reasons for the change, and the question of absolute velocity is not the most important one.

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The probable error of an average plate here is  $\pm 4.0$ , at Allegheny  $\pm 3.3$ . The Seed 23 plates used at Allegheny have an advantage over those used here as, being of a finer grain, the spectrum lines would be easier to measure. Our greater number of observations around periastron ought to have much weight, however, in the consideration of the differences between the two results.

The Allegheny observations, with a correction for  $T$  to bring the times of periastron passage into coincidence, and the addition of 3 km. to each velocity, being a systematic difference, are plotted in Fig. 20, the curve shown representing the elements as determined here. A glance suffices to show that such a curve does not suit the observations as well as their own curve, and it would seem, therefore, that some further work on the subject would be necessary to explain the discrepancies.

THE SYSTEM OF  $\epsilon$  HERCULIS.

$$\alpha = 16^{\text{h}} 56^{\text{m}}.5, \delta = 31^{\circ} 4'.$$

This star was announced as a spectroscopic binary by both the Lick and Yerkes astronomers in 1903. The two plates secured at Lick showed both the  $Mg$  and  $H\gamma$  lines as broad and diffuse. On the three plates secured at Yerkes, Adams noticed evidences of the composite nature of the spectrum.

Work was commenced on the star here May 24, 1907, and up to the present some one hundred spectrograms have been secured. After quite a number of these had been measured, the period was found to be in the neighbourhood of four days. The observations seemed to group themselves into four sets, showing that the period was very close to the integral number. Thus quite an interval elapsed before observations were secured in the intermediate phases.

When in 1908 the curve was fairly complete an attempt was made to bring up the five early observations so as to determine the period with greater accuracy. The period which suited our 1907 and 1908 observations best was 4.012 days. The early observations, made about the same date in 1903, required an increase in the period of .0034 days. As the Lick observations were based on the  $Mg$  line alone and the Yerkes were for the brighter component and were regarded as provisional only, it was decided to confine our attention to our 1907 and 1908 plates alone.

Keeping the two years separate these were grouped into eighteen normal places. When an attempt was made by the graphical method of Dr. King to obtain preliminary values of the elements it was found that no simple elliptic curve would suit. Having previously found in  $\theta$  Aquilæ that the assumption of a secondary disturbance due to the presence of a third body would account very well for deviations in the oscillation curve, a similar assumption was made in regard to this star. Here, however, the residuals from the most suitable elliptic curve seemed to repeat themselves thrice in the period of the main star. It was therefore assumed that there was this third body, if so we may speak of it, revolving about the bright star in a period one-third that of its primary, the two in turn revolving about the other component of the system. This was the theory first acted upon.

After a great many trials the set of elements which gave a resultant curve in best agreement with the observations were the following:—

$$P = 4.012 \text{ days}$$

$$e = .10$$

$$K = 56 \text{ km.}$$

$$\omega = 210^{\circ}$$

$$T = \text{J. D. } 2,417,721.512$$

$$\gamma = -28.15 \text{ km.}$$

$$K' = 12 \text{ km.}$$

$$T' = \text{J. D. } 2,417,722.162$$

= time where secondary crosses primary from above.

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With these elements a set of eighteen observation equations were formed connecting the eight unknown elements with the residuals. These were transformed into normal equations and the solution gave the following corrections to the elements accepted as preliminary. The new values are also given:—

| Elements.      | Corrections. | Corrected Values. |
|----------------|--------------|-------------------|
| $P$ .....      | + 00065 days | 4.01265 days      |
| $c$ .....      | - 030        | 070               |
| $K$ .....      | + 237 km.    | 56237 km.         |
| $\omega$ ..... | - 18.35      | 191.65            |
| $T$ .....      | - 178 days   | J. D. 2417721.334 |
| $\gamma$ ..... | - 1.94 km.   | - 29.19 km.       |
| $K'$ .....     | + 262 km.    | 12262 km.         |
| $T'$ .....     | + 015 days   | J. D. 2417722.177 |

The new set of elements decidedly improved the agreement as is indicated by a decrease in the sum of the squares of the residuals from 1044 to 715, over thirty per cent. When, however, the residuals were computed directly and compared with those obtained by substitution in the observation equations the differences in most cases were larger than they should be, showing that another solution was necessary. Such a solution has as yet not been made.

Before the work had been carried thus far, observations had been made on the star in 1909. To bring these into agreement with the curve the period would need to be increased to 4.023 days; this period if used would utterly destroy the agreement of the first two years. It seemed then that the period was a varying quantity.

At this stage it was decided to review the plates for evidences of the spectrum of the other component. From time to time in measuring, notes had been made regarding any evidences of duplicity, with corresponding velocities, but now the plates were examined critically with this object in view. Out of the hundred odd plates only six showed the doubling of the lines. Two of them showed  $H\gamma$  doubled, two  $H\delta$  doubled and two both  $H\delta$  and  $K$ . The instrument used in almost every case was the single-prism spectrograph which has a dispersion at  $H\gamma$  of 30.2 tenth-metres per millimetre. At  $H\delta$  the instrument should theoretically resolve lines differing in wave-length by 1.2 tenth-metres. This corresponds to a velocity of 90 km. per second. In practice, however, owing to various causes, a separation corresponding to a much greater difference in velocity would be necessary before the lines could be seen as doubled. The maximum separation found to exist is approximately 160 km. Hence, we can understand how such a small percentage of the plates showed the duplicity of the lines. In the case of these six plates the velocities corresponding to the two components are tabulated in the column of remarks, Table II.

In Vol. I., No. 13 of the Allegheny Publications, which came to hand while the plates were being reviewed, Mr. Robert H. Baker discussed the spectroscopic components of 2 Lacerte. His blended curve being very similar to that of  $\epsilon$  Herculis, it seemed possible that the systems might be similar and that his explanation might answer in the case before us. The velocities, while very rough approximations at best, were plotted for each component and elements were obtained for the components as follows:—

| Elements.        | Brighter component. | Fainter component. |
|------------------|---------------------|--------------------|
| Maximum pos. vel | + 64 km.            | + 40 km.           |
| Maximum neg. "   | - 138 "             | - 96 "             |
| <i>K</i>         | 101 "               | 68 "               |
| <i>e</i>         | 15                  | 15                 |
| $\omega$         | 210°                | 30°                |

Physical conditions in the system itself might serve to explain the curious form of the curve, but the two previous theories have much more evidence to support them. The change in the period, if real, would lend strength to the theory of a disturbing satellite. The presence of this third body would tend to cause the line of apsides to rotate, varying the form of the curve and consequently the elements.

Tables I. and II. give all the data of the plates. The residuals for each plate are scaled directly from the curve; the other columns are self-explanatory. Table III. gives the eighteen normal places, the phases being reckoned from the final periastron. The curve, Fig. 21, represents the corrected values of the elements on the assumption of a disturbing body; the dotted lines representing the primary and the secondary, and the heavy continuous one the resultant of the two.

Further work on the star is necessary. Spectrograms of the star at times of maximum velocities are now being secured on plates of fine grain, and it is hoped that some further evidences of the doubling of the lines will thus be secured.

TABLE I.  
EARLY OBSERVATIONS OF  $\epsilon$  HERCULIS.

| Julian Date.  | Phase. | Velocity. | Residual. | Observatory. | Remarks.                 |
|---------------|--------|-----------|-----------|--------------|--------------------------|
| 2,416,235 687 | 3.046  | 58        | .....     | Yerkes.      | .....                    |
| 242 718       | 2.052  | - 43      | .....     | "            | .....                    |
| 259 910       | 3.193  | - 70      | .....     | Lick.        | Mg. line.                |
| 262 827       | 2.098  | - 34      | .....     | "            | "                        |
| 272 664       | 3.910  | - 22      | .....     | Yerkes.      | .....                    |
| 616 680       | 2.837  | - 24*     | .....     | Lick.        | Mg. line, not very good. |
| 658 849       | 2.867  | - 31*     | .....     | "            | Mg. line.                |

\* Kindly communicated by Professor Campbell.

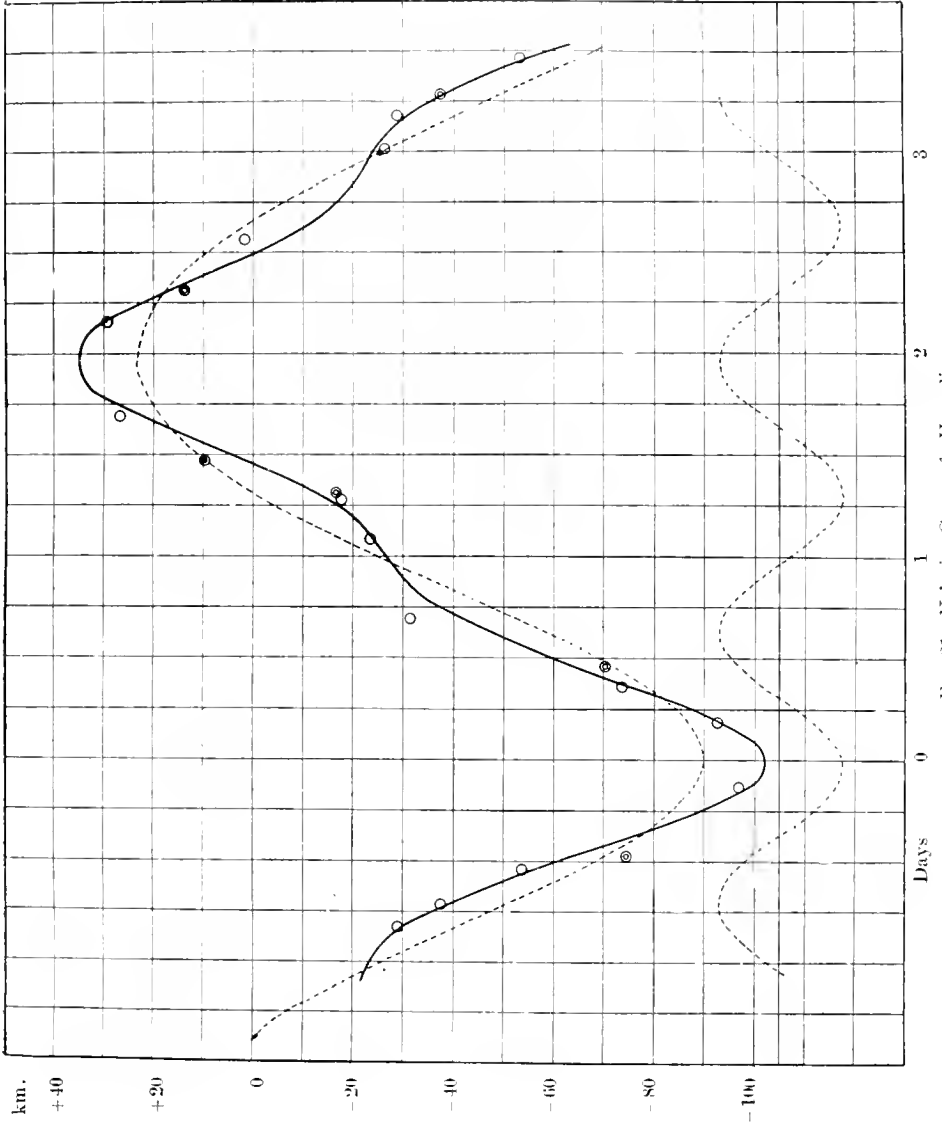
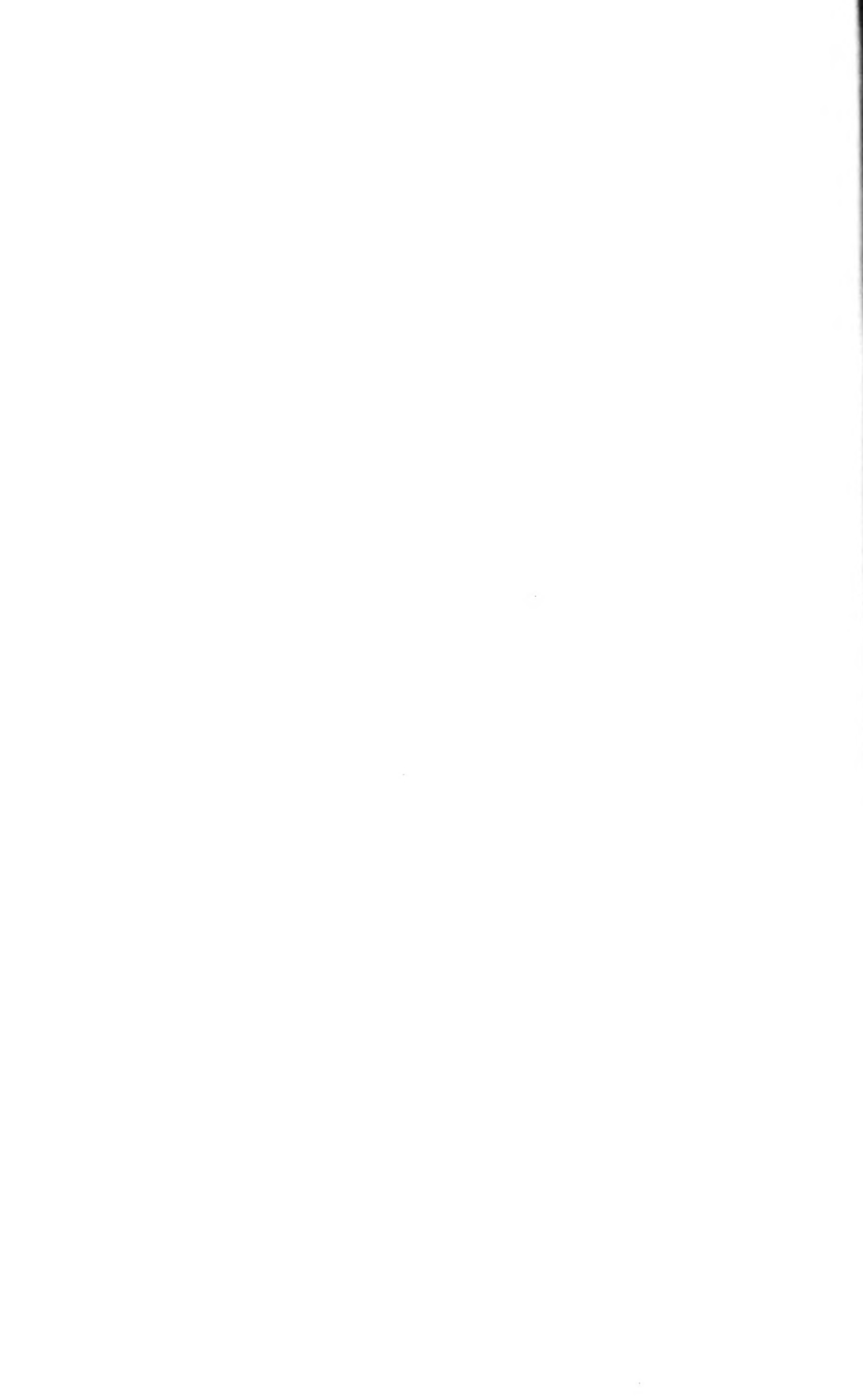


FIG. 21—Velocity Curve of Herctulis.



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TABLE II.  
OTTAWA MEASURES OF  $\epsilon$  HERCULIS.

| No. of Plate. | Julian Date. | Phase. | Velocity | Wt.    | Residual. | Remarks. |                                    |
|---------------|--------------|--------|----------|--------|-----------|----------|------------------------------------|
| 1907.         |              |        |          |        |           |          |                                    |
| 786.....      | 2,417,721    | 767    | 0.433    | -55.6  | 5         | -1.6     |                                    |
| 801.....      | 728          | 735    | 3.388    | -81.4  | 4         | -18.0    |                                    |
| 810.....      | 736          | 812    | 3.410    | -83.7  | 4         | -5.0     |                                    |
| 816.....      | 738          | 741    | 1.356    | +12.7  | 5         | -11.0    |                                    |
| 827.....      | 739          | 652    | 2.267    | -17.8  | 4         | +8.5     |                                    |
| 838.....      | 740          | 774    | 3.389    | -61.7  | 5         | +1.0     | H $\gamma$ 128 and -19             |
| 847.....      | 741          | 767    | 0.370    | -83.2  | 5         | -24.0    |                                    |
| 851.....      | 742          | 738    | 1.341    | +7.0   | 6         | -6.0     |                                    |
| 862.....      | 748          | 692    | 3.282    | -34.5  | 5         | -15.0    | H $\gamma$ 111 and -15 $_2$        |
| 871.....      | 749          | 757    | 0.270    | -65.7  | 5         | -5.0     |                                    |
| 881.....      | 753          | 669    | 0.234    | -80.4  | 3         | -6.0     |                                    |
| 893.....      | 755          | 688    | 2.253    | +4.0   | 3         | -7.0     |                                    |
| 913.....      | 762          | 679    | 1.219    | -21.2  | 2         | -11.0    |                                    |
| 920.....      | 766          | 656    | 1.195    | -17.5  | 7         | -6.0     |                                    |
| 928.....      | 767          | 635    | 2.162    | +9.0   | 5         | -10.0    | Metallic lines seen.               |
| 937.....      | 768          | 622    | 3.149    | -39.0  | 4         | -2.0     |                                    |
| 952.....      | 776          | 673    | 3.175    | -57.6  | 4         | -18.0    |                                    |
| 957.....      | 778          | 693    | 1.182    | -7.0   | 7         | +6.0     |                                    |
| 976.....      | 790          | 722    | 1.173    | -26.8  | 5         | -12.8    |                                    |
| 979.....      | 792          | 562    | 3.013    | +15.4  | 6         | .....    | Mg - 125 $_1$ and +55 $_2$         |
| 987.....      | 795          | 732    | 2.170    | +6.2   | 3         | 12.0     |                                    |
| 1018.....     | 811          | 660    | 2.048    | -30.6  | 3         | 2.6      |                                    |
| 1062.....     | 2,417,840    | 609    | 2.908    | -2.9   | 2         | -22.0    |                                    |
| 1908.         |              |        |          |        |           |          |                                    |
| 1391.....     | 2,418,010    | 868    | 0.623    | -28.6  | 6         | +8.0     |                                    |
| 1403.....     | 017          | 904    | 3.647    | -100.9 | 6         | -9.0     | H $\delta$ - 110 $_1$ and +2S $_1$ |
| 1483.....     | 045          | 900    | 3.555    | -90.7  | 3         | -8.2     | \ 4713 gives +158                  |
| 1491.....     | 047          | 861    | 1.502    | +38.5  | 7         | +22.0    |                                    |
| 1511.....     | 054          | 856    | 0.472    | -37.0  | 7         | +12.4    |                                    |
| 1531.....     | 077          | 813    | 3.367    | -74.0  | 7         | -14.0    |                                    |
| 1540.....     | 080          | 767    | 2.307    | +6.1   | 6         | +1.0     |                                    |
| 1545.....     | 082          | 708    | 0.236    | -74.0  | 5         | +1.5     |                                    |
| 1547.....     | 084          | 770    | 2.298    | -28.5  | 2         | -34.5    |                                    |
| 1567.....     | 094          | 813    | 0.303    | -83.1  | 3         | -14.0    |                                    |
| 1573.....     | 096          | 747    | 2.237    | -11.0  | 6         | -23.5    | K intense to red.                  |
| 1582.....     | 098          | 778    | 0.255    | -65.6  | 5         | +6.6     |                                    |
| 1603.....     | 105          | 774    | 3.239    | -46.2  | 4         | 0.0      |                                    |
| 1625.....     | 115          | 733    | 1.159    | -13.8  | 5         | +0.7     |                                    |
| 1630.....     | 117          | 691    | 3.117    | -31.0  | 8         | +3.5     |                                    |
| 1640.....     | 119          | 710    | 1.121    | +6.1   | 2         | +23.0    | Depends on Mg alone.               |
| 1648.....     | 120          | 715    | 2.129    | +24.8  | 6         | +3.4     |                                    |
| 1653.....     | 124          | 676    | 2.077    | +20.0  | 6         | -5.5     |                                    |
| 1658.....     | 126          | 680    | 0.069    | -99.5  | 3         | -7.0     |                                    |
| 1661.....     | 126          | 826    | 0.208    | -86.1  | 5         | -8.7     |                                    |
| 1666.....     | 129          | 730    | 3.119    | -27.0  | 7         | +8.0     |                                    |
| 1675.....     | 131          | 658    | 1.034    | -14.5  | 6         | +6.8     |                                    |
| 1676.....     | 131          | 688    | 1.064    | -22.2  | 6         | -2.2     | \ 4267 gives +128.                 |
| 1682.....     | 132          | 716    | 2.092    | +31.2  | 6         | +6.2     | H $\delta$ - 80 and +70            |
| 1685.....     | 135          | 609    | 2.966    | -27.9  | 6         | 0.0      | K - 14 and +62.                    |
| 1686.....     | 133          | 649    | 3.026    | -36.0  | 5         | -6.6     | Metallic lines.                    |
| 1693.....     | 134          | 707    | 0.071    | -108.0 | 5         | -16.0    | All lines def. on violet.          |
| 1699.....     | 136          | 679    | 2.042    | -26.0  | 4         | -2.6     |                                    |
| 1707.....     | 137          | 737    | 3.100    | -43.6  | 8         | -9.6     |                                    |
| 1712.....     | 138          | 708    | 0.039    | -81.1  | 5         | +8.1     |                                    |
| 1713.....     | 138          | 739    | 0.083    | -65.8  | 6         | +24.5    |                                    |
| 1719.....     | 139          | 725    | 1.075    | -13.8  | 6         | +6.0     |                                    |
| 1720.....     | 145          | 708    | 3.047    | -23.7  | 7         | +7.0     |                                    |
| 1723.....     | 147          | 583    | 0.908    | -23.8  | 9         | +2.2     |                                    |
| 1728.....     | 148          | 722    | 2.047    | +23.9  | 6         | +5.9     |                                    |
| 1729.....     | 149          | 707    | 3.033    | -17.6  | 8         | +12.2    |                                    |
| 1734.....     | 151          | 716    | 1.028    | -27.8  | 5         | -6.3     |                                    |
| 1737.....     | 152          | 598    | 1.911    | +34.3  | 8         | -0.5     | H $\delta$ - 84 and 28             |
| 1738.....     | 152          | 631    | 1.944    | +34.7  | 5         | +0.7     | K - 115 $_2$ and +32 $_3$          |
| 1743.....     | 152          | 753    | 2.066    | +40.2  | 4         | +13.2    |                                    |
| 1746.....     | 153          | 712    | 3.026    | -22.3  | 3         | +7.0     |                                    |
| 1751.....     | 154          | 653    | 3.967    | -82.5  | 5         | -11.2    |                                    |

TABLE II.  
OTTAWA MEASURES OF  $\epsilon$  HERCULIS.—*Continued.*

| No. of Plate. | Julian Date.  | Phase. | Velocity. | Wt. | Residual. | Remarks. |
|---------------|---------------|--------|-----------|-----|-----------|----------|
| 1908.         |               |        |           |     |           |          |
| 1757.....     | 2,418,154.795 | 0.096  | -94.3     | 5   | -4.8      |          |
| 1760.....     | 155.701       | 1.001  | -22.1     | 3   | +0.4      |          |
| 1761.....     | 159.586       | 0.873  | -28.6     | 8   | -2.2      |          |
| 1774.....     | 161.649       | 2.937  | -24.0     | 7   | +2.5      |          |
| 1782.....     | 169.701       | 2.964  | -35.0     | 7   | -8.7      |          |
| 1793.....     | 173.612       | 2.862  | -47.8     | 5   | -14.1     |          |
| 1818.....     | 178.585       | 3.843  | -92.4     | 7   | +4.2      |          |
| 1838.....     | 181.660       | 2.904  | -24.0     | 7   | 0.0       |          |
| 1844.....     | 182.588       | 3.811  | -98.9     | 8   | -2.8      |          |
| 1853.....     | 185.378       | 2.790  | -6.1      | 5   | +16.0     |          |
| 1866.....     | 189.604       | 2.804  | -20.1     | 4   | -2.0      |          |
| 1903.....     | 216.550       | 1.660  | +11.2     | 4   | -19.0     |          |
| 1905.....     | 217.516       | 2.627  | +21.0     | 5   | -37.8     |          |
| 1906.....     | 217.556       | 2.667  | -10.0     | 5   | +8.0      |          |
| 1917.....     | 220.531       | 1.628  | +18.1     | 2   | -9.1      |          |
| 1926.....     | 227.593       | 0.665  | -26.8     | 4   | +8.3      |          |
| 1961.....     | 259.440       | 0.411  | -70.3     | 4   | -14.2     |          |
| 1983.....     | 272.422       | 1.356  | -30.9     | 5   | -33.0     |          |
| 1993.....     | 278.461       | 3.382  | -30.0     | 5   | +29.0     |          |
| 1909.         |               |        |           |     |           |          |
| 2263.....     | 2,418,346.923 | 3.629  | -43.5     |     |           |          |
| 2264.....     | 346.958       | 3.664  | -39.3     |     |           |          |
| 2305.....     | 360.899       | 1.554  | -18.3     |     |           |          |
| 2306.....     | 360.942       | 1.597  | -16.4     |     |           |          |
| 2327.....     | 369.883       | 2.512  | +49.5     |     |           |          |
| 2328.....     | 369.935       | 2.564  | -12.5     |     |           |          |
| 2370.....     | 379.788       | 0.379  | -78.0     |     |           |          |
| 2371.....     | 379.808       | 0.399  | -54.3     |     |           |          |
| 2384.....     | 381.814       | 2.405  | +36.4     |     |           |          |
| 2385.....     | 381.833       | 2.424  | -38.4     |     |           |          |
| 2454.....     | 397.836       | 2.376  | -30.0     |     |           |          |
| 2455.....     | 397.861       | 2.401  | +29.8     |     |           |          |

TABLE III.  
NORMAL PLACES.

| No.     | Phase from $T$ . | Mean Velocity. | Weight. | Residual O - C. |
|---------|------------------|----------------|---------|-----------------|
| 1.....  | 0.337            | -70.22         | 2       | -6.72           |
| 2.....  | 1.187            | -16.57         | 2       | -4.00           |
| 3.....  | 1.348            | +9.59          | 1       | +8.65           |
| 4.....  | 2.183            | +13.26         | 2       | -4.34           |
| 5.....  | 3.168            | -37.65         | 2       | +0.46           |
| 6.....  | 3.404            | -74.53         | 1       | -11.49          |
| 7.....  | 0.571            | -31.63         | 1.5     | +9.40           |
| 8.....  | 0.952            | -23.75         | 3.5     | +0.67           |
| 9.....  | 1.152            | -17.80         | 3       | -2.87           |
| 10..... | 1.570            | +26.96         | 1       | +4.53           |
| 11..... | 2.034            | -29.16         | 5       | -0.23           |
| 12..... | 2.442            | +1.16          | 2       | +6.97           |
| 13..... | 2.889            | -26.60         | 4       | -2.61           |
| 14..... | 3.062            | -28.98         | 5.5     | +1.78           |
| 15..... | 3.340            | -53.30         | 1.5     | +2.20           |
| 16..... | 3.747            | -96.50         | 2.5     | +1.45           |
| 17..... | 0.048            | -92.52         | 2.5     | +1.26           |
| 18..... | 0.235            | -73.35         | 3       | +1.84           |



## SESSIONAL PAPER No. 25a

THE SPECTROSCOPIC BINARY  $\eta$  BOÖTIS.

This star ( $\alpha = 13^{\text{h}} 49^{\text{m}}.9$ ,  $\delta = +18^{\circ} 54'$ , photographic magnitude 3.8) was announced as a spectroscopic binary by Moore in L. O. B. 70, 1905. The thirteen measures given extended over the years 1897, 1899, 1901, 1903, 1904 and 1905. Of these, four were approximate, the remaining nine definite. Besides these measures there were available the recently published measures\*, six in all, by Kustner of the Bonn Observatory.

Work was commenced on the star here June 25, 1906, and from that time until the date of the last plate mentioned, March 20, 1909, forty-five plates were secured. The determination of the orbit depends then on these sixty-four plates, thirteen of the Lick Observatory, six of the Bonn and the remaining forty-five of our own.

Some objection might be taken to the grouping of observations from different observatories in view of the possibility of a systematic difference in the results used, but it has been deemed expedient by the writer to use these early observations in conjunction with our own to make a preliminary determination of the orbit. Meanwhile plates of the star in the required phases will continue to be made with the new three-prism spectrograph, and when all phases are complete, which cannot be before January, 1910, a new determination of the elements will be made using our three-prism plates alone. The comparison of results ought to be worth the extra labour involved.

The star is of solar type, XIVa according to Miss Maury's grouping, and thus permits of accurate velocity determination. As a rule about fifteen lines were measured on each plate. The plates up to No. 752 were made with the Universal spectroscope, and were reduced by means of the Hartmann interpolation formula. From that time the plates were made with either the new single or the three-prism spectrograph, and were reduced from tables used here in which the micrometer settings for zero displacement of the lines are tabulated. Eleven were made with the former, twenty-one with the latter. The plates used were Seed 27. Our own plates made at the commencement of our work are weighted one-half; later plates with the Universal spectroscope, the single-prism plates, most of those made at Bonn, as well as those of 1897 and 1899 made at Lick, are weighted unity, while the later plates of Lick Observatory and our own new three-prism plates are weighted three.

The following tables contain all the data of the plates. The phases are reckoned from the period and periastron finally adopted and the residuals are scaled directly from the curve representing the final elements:—

## OBSERVATIONS AT LICK OBSERVATORY.

| Julian Date. | Phase. | Velocity. | Weight. | Residual. |
|--------------|--------|-----------|---------|-----------|
| 2,413.959 8  | 192.9  | - 0.6     | 1       | -0.4      |
| 4,035.7      | 268.8  | - 2.      | 1       | +2.3      |
| 4,036.7      | 269.8  | - 4.      | 1       | +0.3      |
| 4,057.6      | 290.8  | - 2.      | 1       | +3.4      |
| 4,693.8      | 431.6  | - 2.2     | 1       | +3.4      |
| 5,524.6      | 271.7  | - 4.9     | 3       | -0.4      |
| 6,259.6      | 16.1   | + 6.9     | 3       | -0.1      |
| 6,542.6      | 299.1  | - 8.2     | 3       | -2.4      |
| 6,571.6      | 328.1  | - 4.9     | 3       | +1.9      |
| 6,603.6      | 360.1  | - 7.6     | 3       | -0.1      |
| 6,646.6      | 403.1  | -10.      | 3       | -2.8      |
| 6,658.6      | 415.1  | - 7.3     | 3       | -0.6      |
| 6,850.9      | 112.1  | + 5.5     | 3       | +0.1      |

\* Astrophysical Journal, 27-5-1908.

## OBSERVATIONS AT BONN OBSERVATORY.

| Julian Date. | Phase. | Velocity. | Weight. | Residual. |
|--------------|--------|-----------|---------|-----------|
| 2,416,258.4  | 14.9   | - 7.6     | 3       | - 0.7     |
| 6,595.5      | 352.0  | - 2.2     | 1       | + 5.2     |
| 6,608.5      | 365.0  | - 4.2     | 1       | - 3.3     |
| 6,994.4      | 255.6  | - 3.4     | 1       | - 0.4     |
| 7,234.7      | 0.6    | - 6.2     | 1       | - 1.5     |
| 7,369.4      | 138.3  | + 3.9     | 1       | - 0.4     |

## OTTAWA OBSERVATIONS.

| Plate Number. | Julian Date. | Phase. | Velocity. | Wt. | Residual. |
|---------------|--------------|--------|-----------|-----|-----------|
| 308           | 2,417,387.7  | 153.6  | - 0.2     | 0.5 | - 2.5     |
| 313           | 389.6        | 155.5  | 0.0       | 0.5 | - 2.2     |
| 318           | 391.6        | 157.5  | + 1.8     | 0.5 | - 0.3     |
| 326           | 396.6        | 162.5  | - 1.7     | 0.5 | - 3.4     |
| 333           | 398.6        | 164.5  | - 1.6     | 0.5 | - 3.2     |
| 366           | 429.6        | 195.5  | - 0.4     | 0.5 | 0.0       |
| 372           | 431.6        | 197.5  | - 4.7     | 0.5 | - 4.2     |
| 657           | 643.8        | 409.7  | - 5.6     | 1.0 | - 1.3     |
| 670           | 655.8        | 421.7  | - 6.9     | 1.0 | - 0.6     |
| 691           | 669.7        | 435.6  | - 10.2    | 1.0 | - 5.0     |
| 731           | 685.8        | 451.7  | - 3.8     | 1.0 | - 0.5     |
| 739           | 692.7        | 458.6  | - 4.5     | 1.0 | - 2.3     |
| 752           | 703.6        | 469.5  | + 0.7     | 1.0 | + 0.9     |
| 760           | 710.7        | 476.6  | - 0.1     | 3.0 | - 1.2     |
| 764           | 716.7        | 482.6  | + 2.9     | 3.0 | + 0.7     |
| 769-771       | 718.7        | 484.6  | + 2.5     | 2.0 | - 0.2     |
| 771           | 719.6        | 485.5  | + 3.2     | 1.0 | + 0.4     |
| 779           | 720.6        | 486.5  | + 0.6     | 1.0 | - 2.4     |
| 793           | 725.7        | 491.6  | + 5.7     | 1.0 | + 1.7     |
| 797           | 727.6        | 493.5  | + 5.1     | 1.0 | + 0.8     |
| 812           | 737.6        | 8.1    | + 7.2     | 1.0 | + 1.4     |
| 868           | 748.6        | 19.1   | + 5.0     | 1.0 | - 2.4     |
| 891           | 754.6        | 25.1   | + 5.7     | 1.0 | - 2.3     |
| 918           | 765.6        | 36.1   | + 6.8     | 1.0 | - 1.8     |
| 950           | 775.6        | 46.1   | + 5.3     | 1.0 | 3.5       |
| 972           | 789.6        | 60.1   | + 11.4    | 1.0 | - 2.8     |
| 990           | 795.6        | 66.1   | + 9.0     | 3.0 | - 0.6     |
| 1231          | 955.9        | 226.4  | - 3.3     | 1.0 | - 1.1     |
| 1294          | 968.8        | 239.3  | - 3.8     | 3.0 | - 0.9     |
| 1307          | 970.9        | 241.4  | - 3.5     | 3.0 | - 0.4     |
| 1332          | 989.9        | 260.4  | - 5.2     | 3.0 | - 1.2     |
| 1357          | 996.8        | 267.3  | - 7.1     | 3.0 | - 2.7     |
| 1446          | 2,418,031.9  | 302.4  | - 7.5     | 3.0 | - 1.6     |
| 1513          | 066.8        | 337.3  | - 6.7     | 3.0 | - 0.3     |
| 1557          | 085.7        | 356.2  | - 8.7     | 3.0 | - 1.3     |
| 1553          | 087.7        | 358.2  | - 6.6     | 3.0 | - 0.3     |
| 1621          | 115.6        | 386.1  | - 6.0     | 3.0 | - 1.0     |
| 1663          | 129.6        | 400.1  | - 7.4     | 3.0 | - 0.1     |
| 1710          | 138.6        | 409.1  | - 6.8     | 3.0 | - 0.2     |
| 1792          | 173.5        | 444.0  | - 8.6     | 3.0 | - 4.3     |
| 1867          | 192.5        | 463.0  | - 0.3     | 3.0 | - 1.2     |
| 2115          | 315.0        | 96.2   | + 8.6     | 3.0 | + 1.7     |
| 2209          | 337.8        | 113.0  | + 5.2     | 3.0 | - 0.2     |
| 2283          | 355.8        | 131.0  | + 6.0     | 3.0 | + 2.1     |
| 2396          | 386.7        | 161.9  | + 2.8     | 3.0 | + 1.0     |

The observations when plotted gave a period about 492 days. Using this period they are combined into twenty-one groups, no group including observations of different periods. Preliminary elements were determined by the graphical method\* of Dr.

\* A. J., 27-2-1908.

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King and, using these, twenty-one observation equations of the form of Lehmann-Filhés were formed. They were then transformed into the following normal equations, where for sake of homogeneity these substitutions were made:

$$\begin{aligned} x &= \delta\gamma \\ y &= \delta K \\ z &= K \cdot \delta e \\ u &= K \cdot \delta \omega \\ v &= 1000 \cdot \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \delta \mu \\ w &= \mu \cdot \frac{K}{(1 - e^2)^{\frac{3}{2}}} \cdot \delta T. \end{aligned}$$

The normal equations are:—

$$\begin{aligned} 116\ 000x - 11\ 974y + 1\ 830z + 19\ 935u - 2\ 354v - 20\ 565w + 6\ 260 &= 0 \\ 54\ 535y - 14\ 444z + 2\ 376u - 13\ 460v - 7\ 212w - 28\ 055 &= 0 \\ 57\ 796z - 2\ 404u - 4\ 352v + 3\ 883w - 19\ 760 &= 0 \\ 59\ 931u - 13\ 104v - 62\ 528w - 4\ 652 &= 0 \\ 45\ 343v + 14\ 515w + 40\ 046 &= 0 \\ 69\ 129w + 7\ 200 &= 0 \end{aligned}$$

The solution of these equations gave as corrections:

$$\begin{aligned} \delta\gamma &= -\ .02 \text{ km.} \\ \delta K &= +\ .43 \text{ " } \\ \delta e &= +\ .050 \\ \delta\omega &= -\ 1^\circ.025 \\ \delta P &= +\ 3.32 \text{ days} \\ \delta T &= -\ .520 \text{ " } \end{aligned}$$

The sum of the squares of the residuals for the normal places was reduced from 186.1 to 122.7, and the agreement between equation and ephemeris residuals was considered satisfactory. These are given in the accompanying table of normal places:

NORMAL PLACES.

| No. | Mean Phase. | Mean Vel. | Wt. | Residual. | Equation-Ephemeris. |
|-----|-------------|-----------|-----|-----------|---------------------|
| 1.  | 255.5       | -2.15     | 4   | +1.64     | -0.13               |
| 2.  | 431.6       | -2.20     | 1   | +3.41     | -0.08               |
| 3.  | 271.7       | -4.90     | 1   | -0.33     | -0.26               |
| 4.  | 15.5        | -7.25     | 6   | +0.28     | -0.08               |
| 5.  | 333.0       | -6.90     | 16  | +0.02     | -0.56               |
| 6.  | 112.1       | +5.50     | 3   | +0.11     | +0.14               |
| 7.  | 255.6       | -3.40     | 1   | -0.39     | -0.03               |
| 8.  | 0.6         | +6.20     | 1   | +1.50     | -0.13               |
| 9.  | 138.3       | +3.90     | 1   | +0.45     | +0.29               |
| 10. | 435.5       | -6.20     | 5   | -0.96     | +0.01               |
| 11. | 417.7       | -7.60     | 9   | -0.98     | -0.01               |
| 12. | 480.8       | +1.63     | 11  | -0.21     | +0.03               |
| 13. | 463.0       | -0.30     | 3   | +1.19     | -0.12               |
| 14. | 0.9         | +6.00     | 3   | +1.25     | -0.04               |
| 15. | 48.1        | +7.65     | 8   | -1.17     | -0.02               |
| 16. | 111.4       | +6.60     | 9   | +1.16     | +0.02               |
| 17. | 161.9       | +2.80     | 3   | +1.02     | 0.00                |
| 18. | 169.5       | -0.97     | 3   | -2.23     | 0.00                |
| 19. | 238.4       | -3.60     | 7   | -0.70     | -0.32               |
| 20. | 276.7       | 6.60      | 9   | -1.81     | -0.02               |
| 21. | 359.4       | -7.00     | 12  | 0.49      | -0.06               |

The probable error of a plate as determined from the last two columns of the table, giving the data of the plates and using the formula  $r = \pm .6745 \sqrt{\frac{\sum p^2 v^2}{\sum p - 1}}$  is  $\pm 1.04$  km. per second. The curve, Fig. 22, is plotted from the corrected elements given in the following table. These are considered close approximations to the true values until observations in all phases of the star have been secured with the three-prism spectrograph when a final determination will be made:—

## ELEMENTS OF ORBIT.

| Elements.                                   | Graphical.      | Corrected.       |
|---|-----------------|------------------|
| Period $P$ .....                            | 492 days.       | 495.3 days.      |
| Eccentricity $e$ .....                      | 0.25            | 0.300            |
| Longitude of apse $\omega$ .....            | 300             | 298° 98          |
| Half amplitude $K$ .....                    | 7.8 km.         | 8.23 km.         |
| Velocity of system $\gamma$ .....           | -0.57 km.       | -0.60 km.        |
| Periastron passage $T$ .....                | J. D. 2417730.0 | J. D. 2417729.48 |
| Projection semi-major axis $a \sin i$ ..... |                 | 53,474,000 km.   |
| $p_{\text{pr}}$ .....                       | 186 1           | 122.7            |

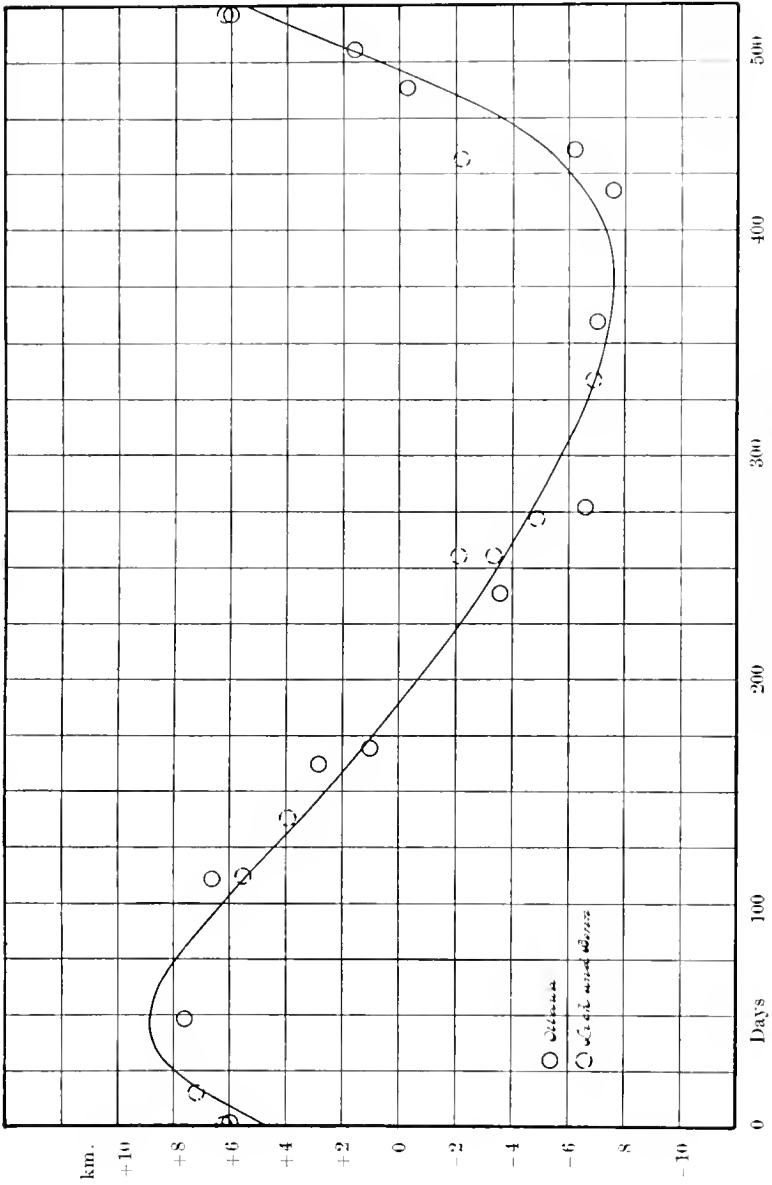


FIG. 22.—Velocity Curve of  $\eta$  Bootis.



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## APPENDIX B.

THE SPECTROSCOPIC BINARY,  $\alpha$  CORONÆ BOREALIS.

J. B. CANNON.

The star  $\alpha$  Coronæ Borealis ( $\alpha = 15^{\text{h}} 30^{\text{m}}$ ;  $\delta = + 27^{\circ} 3'$ ), was discovered to be a binary by Hartmann from measures of six plates taken at Potsdam in 1902 and 1903.\* It was under observation at this Observatory during the years 1907 and 1908. In all 103 plates were secured, 46 in 1907 and the remaining 57 in 1908; the instrument used being the single-prism spectroscope.

This star belongs to the class Ia 2 in the Vogel classification. The spectrum shows the dark lines,  $H_{\beta}$ ,  $H_{\gamma}$ ,  $H_{\delta}$ ,  $H_{\epsilon}$ , the magnesium line  $\lambda 4481$ , the iron line  $\lambda 4549$ , the calcium line  $\lambda 3934$  and a few other very faint lines. The hydrogen lines are all very broad and diffuse and very difficult of accurate measurement.  $H_{\epsilon}$  is so diffuse that it has not been measured at all. The line  $\lambda 4481$  varies in character, in some plates well defined, in others diffuse. The line  $\lambda 4549$  is very faint and has only been measured in a very few cases. The line  $\lambda 3934$  is in general a fairly good line, being weighted about the same as  $H_{\gamma}$  and  $H_{\delta}$ . In the measurement of nearly every plate it was found that the lines  $\lambda 4481$  and  $\lambda 4549$  gave entirely different velocities from the  $H$  lines and  $K$ . It was decided therefore to consider only  $H_{\beta}$ ,  $H_{\gamma}$ ,  $H_{\delta}$  and  $K$  in the first measurements and the elements determined in this treatment are from the consideration of these alone.

The lines measured, together with the velocities per revolution of the micrometer screw (0.5 pitch), are given in Table I.

TABLE I.  
LINES (MEASURED) IN  $\alpha$  CORONÆ BOREALIS.

| Element.       | Wave-Length. | Velocity per revolution. |
|----------------|--------------|--------------------------|
| Hydrogen ..... | 4861.527     | 1451                     |
| " .....        | 4340.634     | 1044                     |
| " .....        | 4101.890     | 868                      |
| cium .....     | 3933.825     | 749                      |

These lines vary in quality and were weighted accordingly. The whole plate was then weighted, regard being had, first, to the appearance of the spectrum, and second and more particularly, to the number of lines measured and the agreement in the measurements. The velocities found were plotted successively and gave a period of between seventeen and eighteen days. Trials of several periods ranging between these, gave 17.35 as the most satisfactory. There were available measurements of three plates of 1902 and ten of 1903 taken at Potsdam\*, and it was found that on plotting these with the observations obtained here that if the period were increased to 17.355 days, they would, with one exception, lie very close to the curve. Table II. contains

\* A. N., 163, 31, 1903.

the number of the plate, the Julian date, the phase—computed from the time of periastron finally accepted, and period 17.355 days,—the weight of the plate, the velocity and the residual between the observed velocity and that computed from the corrected elements.

In order to obtain observations in which the errors might be reduced and a curve drawn showing smaller residuals, the one hundred and three observations were combined into fourteen groups. Plates of both years were combined indiscriminately, those at nearly the same phase being grouped together. The weight of each plate (Table II.) was taken into account and the weighted mean of each group computed, with the mean phase.

(Table III. contains the mean phase from  $T$  mean velocity, weight and residual of these normal places.)

TABLE II.  
MEASURES OF  $\alpha$  CORONÆ BOREALIS.

| Plate No.     | Year. | Julian Day.  | Phase. | Wt. | Velocity. | Residual. |
|---------------|-------|--------------|--------|-----|-----------|-----------|
| 784           | 1907  | 2,417,720.74 | 13.041 | 4   | -40       | +12.5     |
| 790           | "     | 725.63       | 0.576  | 4   | +32       | 0.        |
| 794           | "     | 725.75       | 0.696  | 3   | -44       | -10.      |
| 800           | "     | 727.72       | 2.666  | 3   | +17       | +17.      |
| 808           | "     | 735.69       | 10.656 | 3   | -37       | +15.      |
| 813           | "     | 737.64       | 12.581 | 4   | -30       | +3.       |
| 830           | "     | 738.74       | 13.681 | 2   | -26       | 0.        |
| 837           | "     | 739.73       | 14.671 | 4   | -17       | -3.5      |
| 845           | "     | 740.69       | 15.641 | 3   | -1        | -8.       |
| 850           | "     | 741.69       | 16.641 | 4   | +11       | -1.5      |
| 861           | "     | 747.67       | 5.266  | 2   | +17       | -4.5      |
| 869           | "     | 748.64       | 6.236  | 4   | +9        | -4.5      |
| 880           | "     | 752.65       | 10.246 | 1   | -41       | +20.      |
| 888           | "     | 753.62       | 11.216 | 2   | -27       | -3.       |
| 892           | "     | 754.64       | 12.236 | 4   | -28       | -1.       |
| 912           | "     | 761.64       | 1.876  | 2   | +25       | +13.5     |
| 917           | "     | 762.64       | 2.876  | 3   | +30       | -2.5      |
| 919           | "     | 765.65       | 5.886  | 3   | +8        | 0.        |
| 927           | "     | 766.61       | 6.846  | 3   | -5        | +4.5      |
| 936           | "     | 767.58       | 7.816  | 4   | -8        | -15.      |
| 939           | "     | 769.68       | 9.916  | 3   | -29       | -10.      |
| 941           | "     | 770.64       | 10.876 | 1   | -30       | -7.       |
| 944           | "     | 773.62       | 13.851 | 2   | -26       | -0.5      |
| 951           | "     | 775.62       | 15.851 | 3   | -19       | -15.      |
| 956           | "     | 777.67       | 0.546  | 3   | -32       | 9.        |
| 973           | "     | 789.58       | 11.466 | 2   | -16       | -9.       |
| 978           | "     | 791.54       | 14.421 | 3   | -24       | +1.5      |
| 986           | "     | 794.69       | 0.216  | 2   | -12       | +16.      |
| 1060 and 1061 | "     | 839.77       | 10.386 | 2   | -25       | +4.       |
| 1066          | "     | 800.69       | 6.216  | 2   | -14       | -18.      |
| 1014          | "     | 803.63       | 9.156  | 2   | -7        | -8.5      |
| 1017          | "     | 810.63       | 16.161 | 1   | -14       | +13.      |
| 1022          | "     | 811.66       | 17.151 | 1   | +5        | -15.      |
| 1026          | "     | 815.50       | 3.676  | 3   | +30       | -4.       |
| 1032          | "     | 825.57       | 13.741 | 2   | -22       | -3.5      |
| 1037          | "     | 831.67       | 2.486  | 2   | +36       | -0.5      |
| 1047 and 1048 | "     | 837.53       | 8.356  | 3   | -15       | +5.       |
| 1083 and 1084 | "     | 850.56       | 4.016  | 4   | +26       | -2.5      |
| 1393          | 1908  | 2,418,010.92 | 8.186  | 3   | -5        | +0.5      |
| 1402          | "     | 017.87       | 15.136 | 3   | -17       | +1.       |
| 1493          | "     | 047.80       | 10.356 | 3   | -6        | -15.      |
| 1571 and 1572 | "     | 096.69       | 7.181  | 3   | -15       | +12.5     |
| 1581          | "     | 098.73       | 9.221  | 1   | -5        | -10.      |
| 1601          | "     | 105.71       | 16.201 | 3   | +7        | +5.5      |
| 1608          | "     | 110.58       | 3.716  | 3   | +9        | +17.      |
| 1623 and 1624 | "     | 115.69       | 8.831  | 4   | -14       | +1.       |
| 1628 and 1629 | "     | 117.64       | 10.776 | 3   | -11       | -11.5     |
| 1638 and 1639 | "     | 119.66       | 12.796 | 4   | -21       | -6.5      |
| 1646 and 1647 | "     | 120.68       | 13.816 | 3   | -21       | -4.5      |
| 1652          | "     | 124.64       | 0.421  | 3   | +42       | -11.      |
| 1656 and 1657 | "     | 126.64       | 2.421  | 3   | +27       | +10.      |
| 1655          | "     | 129.70       | 5.481  | 3   | +12       | -1.       |



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TABLE II.  
MEASURES OF  $\alpha$  CORONÆ BOREALIS—Continued.

| Plate No.              | Year. | Julian Day.  | Phase. | Wt. | Velocity. | Residual. |
|------------------------|-------|--------------|--------|-----|-----------|-----------|
| 1673 and 1671          | 1908. | 2,418,131.62 | 7.401  | 4   | - 3       | - 1.5     |
| 1683 and 1684          | "     | 133.57       | 9.351  | 3   | - 18      | - 2.      |
| 1692                   | "     | 134.68       | 10.461 | 2   | 29        | + 7.5     |
| 1697 and 1698          | "     | 139.65       | 12.431 | 4   | 24        | - 3       |
| 1711                   | "     | 138.68       | 14.461 | 4   | 17        | - 5.      |
| 1721 and 1722          | "     | 147.54       | 5.966  | 6   | 0         | - 7.      |
| 1739                   | "     | 152.65       | 11.076 | 2   | - 44      | - 20.     |
| 1748 and 1749          | "     | 154.57       | 12.996 | 6   | - 36      | - 8.5     |
| 1764                   | "     | 159.61       | 0.711  | 4   | + 37      | - 3.      |
| 1773 and 1775          | "     | 161.60       | 2.671  | 7   | - 43      | - 8.5     |
| 1798                   | "     | 174.54       | 15.611 | 2   | - 16      | - 6.      |
| 1809                   | "     | 175.62       | 16.681 | 3   | - 3       | + 13.     |
| 1816 and 1817          | "     | 178.55       | 2.266  | 6   | + 41      | - 4.      |
| 1827                   | "     | 179.54       | 3.256  | 2   | + 27      | + 2.5     |
| 1836                   | "     | 181.61       | 5.326  | 4   | + 10      | + 2.      |
| 1841 and 1842          | "     | 182.54       | 6.256  | 7   | + 8       | - 3.5     |
| 1852                   | "     | 185.56       | 9.276  | 2   | - 15      | - 0.5     |
| 1861                   | "     | 188.53       | 12.246 | 4   | - 30      | + 3.5     |
| 1865                   | "     | 189.56       | 13.276 | 1   | - 15      | - 12.     |
| 1882 and 1883          | "     | 199.54       | 5.901  | 8   | + 11      | - 3.5     |
| 1894, '95, '96 and '97 | "     | 204.50       | 10.861 | 10  | - 21      | - 2.      |
| 1949, 1950 and 1951    | "     | 247.45       | 1.746  | 6   | + 46      | - 7.5     |
| 1991                   | "     | 278.42       | 15.261 | 1   | + 8       | - 20.     |

TABLE III.

NORMAL PLACES OF  $\alpha$  CORONÆ BOREALIS.

| No. | Mean Phase. | Mean Velocity. | Wt. | Residual. |
|-----|-------------|----------------|-----|-----------|
| 1   | 12.656      | - 29.77        | 6   | - 2.37    |
| 2   | 13.777      | - 23.54        | 2   | - 2.34    |
| 3   | 14.664      | - 18.50        | 3   | - 2.29    |
| 4   | 15.831      | - 5.77         | 2.5 | - 0.36    |
| 5   | 16.723      | + 5.00         | 1.5 | - 6.22    |
| 6   | 0.556       | + 34.63        | 4   | - 2.17    |
| 7   | 2.302       | + 37.14        | 6   | - 0.71    |
| 8   | 3.559       | + 24.33        | 3   | + 2.66    |
| 9   | 5.657       | + 11.10        | 4   | - 2.47    |
| 10  | 6.250       | + 2.41         | 4   | + 1.46    |
| 11  | 7.968       | - 6.71         | 4   | - 1.65    |
| 12  | 9.444       | - 17.27        | 2   | + 0.31    |
| 13  | 10.517      | - 22.21        | 3   | - 0.25    |
| 14  | 11.000      | - 24.35        | 3   | + 0.75    |

From the radial velocity curve the elements of the orbit were determined by the graphic method of Dr. King.\* These were:—

- $P = 17.355$  days
- $T = \text{J. D. } 2,417,725.55$
- $K = 33$  km.
- $e = .28$
- $\omega = 309^\circ$
- $\gamma = 0$  km.

\* Astro. Journal, Vol. XXVII.

To obtain elements which would give a curve more nearly suiting the normal places, a least-square solution was made. On the advice of Mr. Plaskett, the period 17.355 days was taken as fixed, and the fourteen observation equations (formed by the method of Lehmann-Fillé's<sup>23</sup>) were determined without considering  $\delta\mu$ . From these the following normal equations result:—

$$\begin{aligned} -48x - 0.4500y - 3.7267z + 1.1799u + 2.8166v - 14.1350-n &= 0 \\ +24.0451y - 7.2422z + .4420u - .1050v - 4.1083-n &= 0 \\ +23.0108z - .2779u - .8737v + 3.9440-n &= 0 \\ +19.5267u + 17.5676v + 63.4280-n &= 0 \\ +17.8291v - 67.9099-n &= 0 \end{aligned}$$

Where

$$\begin{aligned} x &= \delta\gamma \\ y &= \delta K \\ z &= K\delta e \\ u &= -K\delta\omega \\ v &= \frac{K\mu\delta T}{(1-e^2)^{\frac{3}{2}}} \end{aligned}$$

The solution of the above equations gave the corrections to the element:—

$$\begin{aligned} \delta\gamma &= +.635 \text{ km.} \\ \delta K &= -.031 \text{ km.} \\ \delta e &= -.015 \\ \delta\omega &= -3^{\circ}.76 \\ \delta T &= -.449 \text{ days.} \end{aligned}$$

and hence the following new elements:—

$$\begin{aligned} \gamma &= +.635 \text{ km.} \\ K &= 32.969 \text{ km.} \\ e &= .265 \\ \omega &= 305^{\circ}.24 \\ T &= 2,417.725.101 \text{ J. D.} \\ P &= 17.355 \text{ days.} \end{aligned}$$

An ephemeris computed with these elements reduces the value of  $\Sigma pvr$  from 498.94 to 217.35, but the differences found between these residuals and the observation equation residuals were in some cases rather large, and at a suggestion by Mr. Harper—whom I owe much for other valuable suggestions as well—a second solution was made. This time  $\delta K$  was omitted owing to the small correction obtained in the first solution, and the new observation equations contain only four unknowns, and hence only four normal equations follow:—

$$\begin{aligned} 48x + 2.0615y + 1.1149z + 2.0989u + 6.1200-n &= 0 \\ +24.8703y + .2750z + .3566u - 9.4127-n &= 0 \\ +19.7284z + 18.6666u - 5.8754-n &= 0 \\ +19.2174u - 4.4691-n &= 0 \end{aligned}$$

in which

$$\begin{aligned} x &= \delta\gamma \\ y &= K\delta e \\ z &= -K\delta\omega \\ u &= \frac{K\mu\delta T}{(1-e^2)^{\frac{3}{2}}} \end{aligned}$$

The solution gives the corrections:—

$$\begin{aligned} \delta\gamma &= -.137 \\ \delta e &= +.012 \\ \delta\omega &= -1^{\circ}.558 \\ \delta T &= -.0475 \end{aligned}$$

\* A. N., 136, 17, 1894.

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The probable error of a normal place of unit weight was computed and found to be  $\pm 3.07$ , that of a plate as determined from the residual for each plate scaled from the curve to be  $\pm 5.386$ . The probable error of each element was also computed and is attached to the final values below, the values obtained after applying the corrections found in the second least-squares solution:—

$$\begin{aligned} \gamma &= + .498 \text{ km. } \pm .330 \text{ km.} \\ K &= 32.969 \text{ km.} \\ e &= .277 \pm .0012 \\ \omega &= 303^{\circ}.68 \pm 4^{\circ}.25 \\ T &= 2,417,725.054 \text{ J. D. } \pm .187 \\ P &= 17.355 \text{ days} \\ a \sin i &= 7,560,000 \end{aligned}$$

These values give a second reduction of  $\Sigma pvt$  from 217.35 to 207.7 and satisfactory differences between equation and ephemeris residuals, the average being  $-.08$ . The curve shown is drawn from the above elements and the circles show the position of the observed normal places.

Since the completion of the foregoing treatment of the binary, from the point of view of the hydrogen lines and the calcium line,  $\lambda 3934$ , all the plates have been reviewed, and the magnesium line  $\lambda 4481$  carefully measured where measurement was possible, with the intent of determining in what respects the orbit deduced from this line might differ from that already determined from the other lines. The method of treatment was exactly similar to that formerly followed. The period was taken as before—17.355 days. The observations were grouped into normals, the same plates being taken together as in the former treatment and the relative weights assigned as before. The normals were plotted, and the best curve possible drawn through them, or rather the graphic method of Dr. King was employed to obtain the elements of the orbit, the velocity curve corresponding to which best suited these normal places.

The elements thus found were as follows:—

$$\begin{aligned} \gamma &= + 6.69 \text{ km.} \\ K &= 33 \text{ km.} \\ e &= .35 \\ P &= 17.355 \text{ days.} \\ \omega &= 316^{\circ} \end{aligned}$$

Comparing these with the corresponding elements from the other lines, the main differences are seen to be in the values of  $\gamma$  and  $e$ .

In the work which has been done on the radial velocities of stars other than binary, some stars have been found, certain of whose lines gave consistently different velocities from other lines. Among them is  $\sigma$  Ceti, the emission and absorption lines giving a considerable difference in the value of the radial velocity; so with nearly all Novæ. Nova Aurigæ has been discussed at some length by several astronomers and a similar phenomenon has been noted. Explanations have been suggested as to the cause of the different displacement of different lines. These consist chiefly of two.—first, a lagging envelope producing the lines of less displacement towards the red end of the spectrum, and second, an ever-expanding envelope coming from a continuously productive source. How far such conditions would go to explain a state of affairs such as we find in  $\alpha$  Coronæ, it is difficult to say. We may also look upon the system as receding with a velocity of 6.69 km. per second—the velocity given by the magnesium line—and constantly expelling hydrogen and calcium vapors, the velocity of expulsion affected by the periodic recurrence of physical conditions, brought about by the changing relative positions of the stars in the orbit, which conditions fail to influence magnesium in any way so far as changes in the lines are concerned. This is quite plausible, for in

the spectroscopic study of the Sun's surface, regions have been found, such as sun-spots, the spectra of which show certain lines considerably affected in character and position, while other lines denoting other elements remain unchanged.

After the first part of this work had been completed, Mr. Jordan issued from the Allegheny Observatory his publication on the Orbit of  $\alpha$  Coronæ Borealis. Comparing his results with those obtained here from the lines  $H\epsilon$ ,  $H\gamma$ ,  $H\delta$  and  $K$ , it was seen that, although on the whole they agreed fairly well, there was considerable difference in the values of  $e$ . This is largely due no doubt to the fact that Mr. Jordan used the line (Mg)  $\lambda$  4481, together with the above lines in the determination of his elements. However, the fact that the plates we obtained here were measured by several men and all agreed that the Mg line gave large discrepancies seems to justify the separate treatment.

The accompanying curves represent—Fig. 23, the hydrogen and calcium curve, and Fig. 24 the curve from the hydrogen and calcium lines, and that from the magnesium lines.

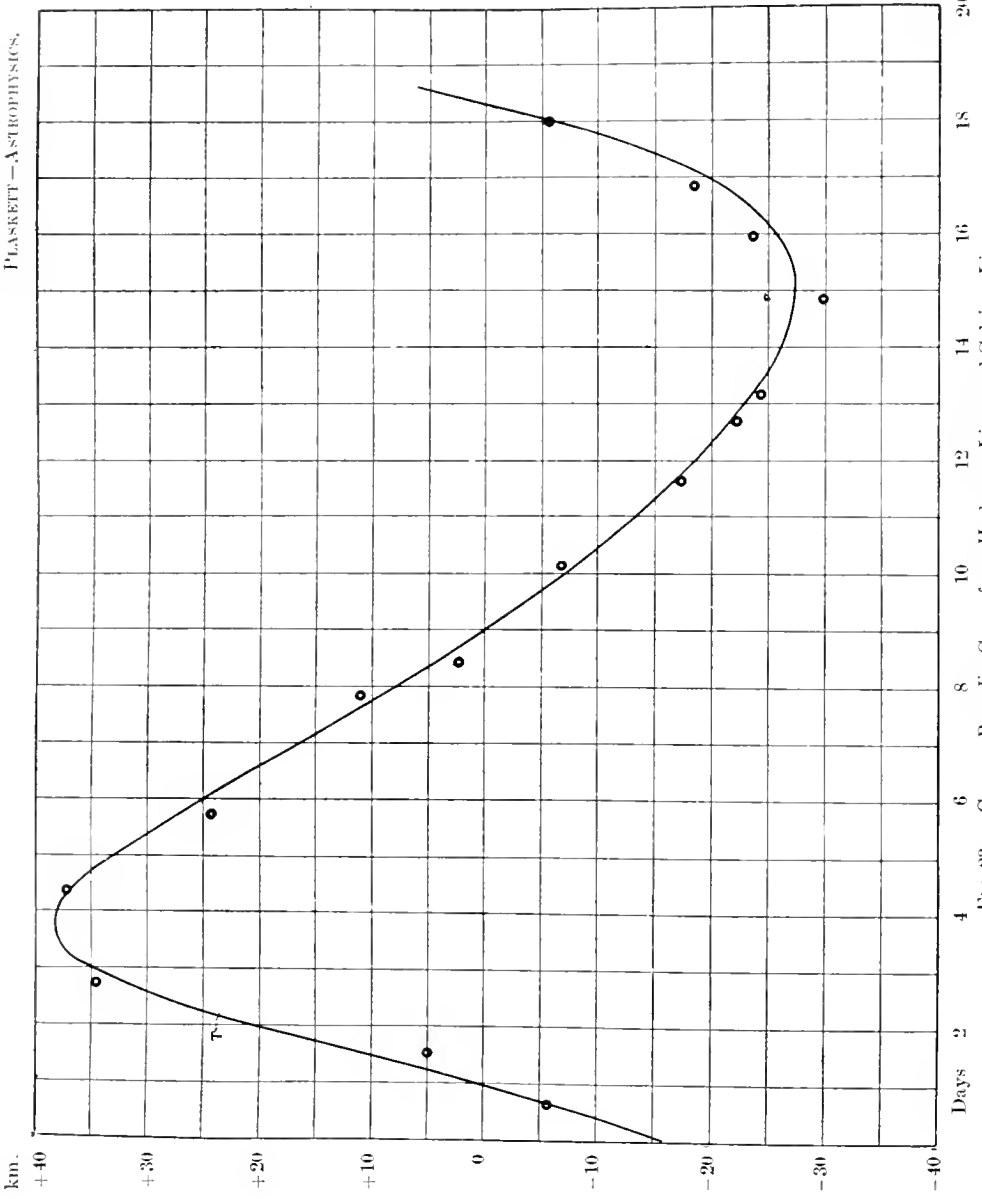


Fig. 23— $\alpha$  Coronae Borealis, Curve from Hydrogen Lines and Calcium Line.



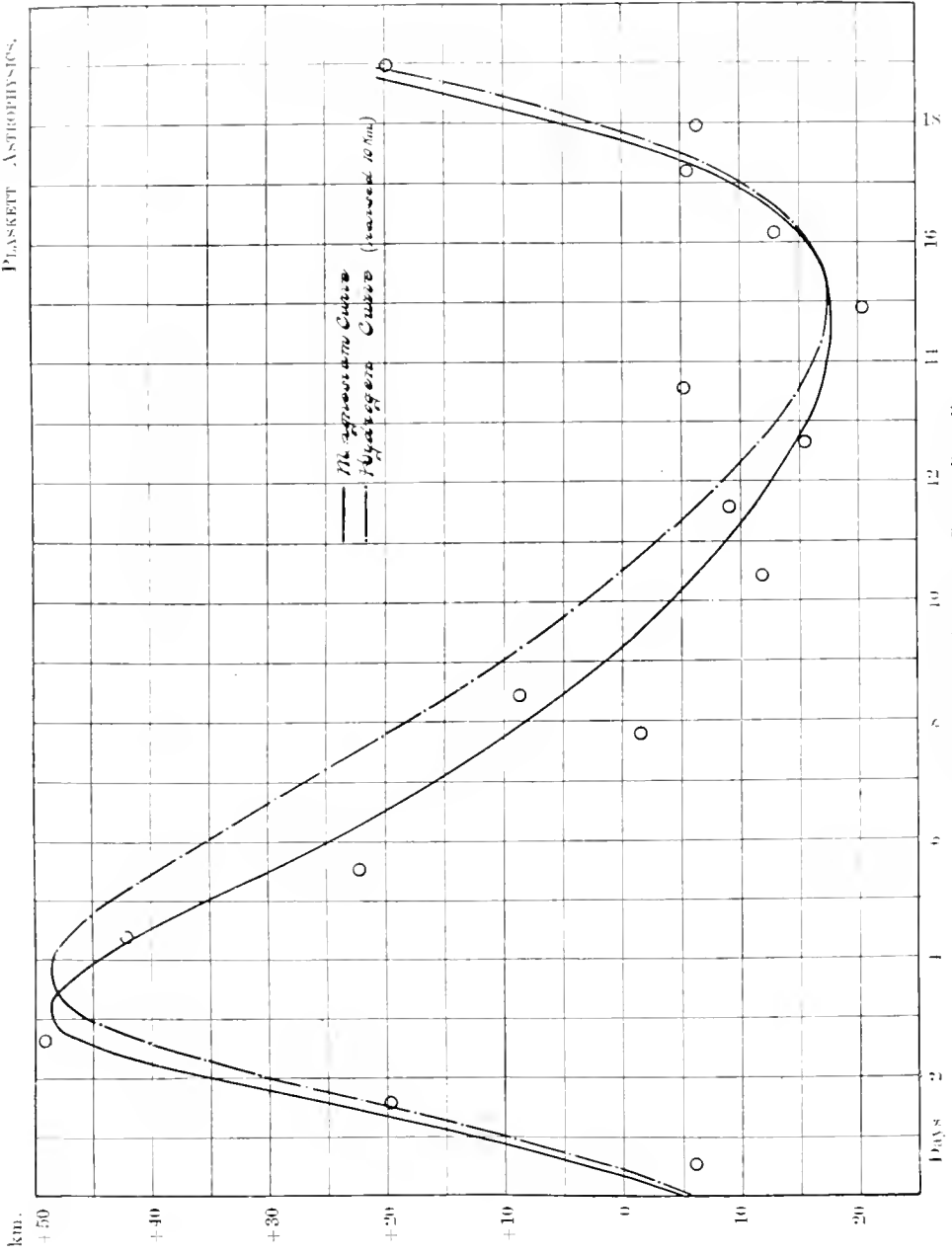


FIG. 24—Velocity Curve of a Coronar Bombard.





## APPENDIX C.

## THE TWENTY-THREE FOOT SOLAR SPECTROGRAPH.

RALPH E. DELURY.

This instrument is adapted for analyzing with great dispersion the light of the sun and of laboratory sources, such as the electric spark, arc, flame, &c., and is primarily intended for investigating the conditions in the sun. It is situated in the basement of the Observatory in the Solar Research Room, which is connected on the north side by a cement tunnel to the louvred passage of the Coelostat House from which the image of the sun is directed to the spectrograph, and on the east side to the Chemical Laboratory, which is used also as a photographic dark-room in which are developed the photographs of the spectra taken in the spectrograph. The spectrograph may be described under the following heads:—(a) Optical Parts; (b) Mountings; (c) Slit-Attachment; (d) Camera and Plate-Holders; (e) Guide-plate for the Sun's Image.

*(a) Optical Parts.*

The optical parts are:—a slit with metal jaws 1.3 in. (3.4 cm.) long, mounted so as to leave 1 in. (2.5 cm.) clear, and provided with a micrometer, for adjusting the width of the slit, reading to thousandths of an inch; a six-inch (15 cm.) collimating lens of 22 ft. 10 in. (695.5 cm.) focal length for yellow light; and one of the earlier Michelson plane gratings of speculum metal having a 4.25 in. by 4.75 in. (10.8 cm. by 12 cm.) surface ruled 12,700 lines to 1 in. (500 lines to 1 mm.). These parts are arranged after the plan described by O. Von Littrow in 1863 (see Kayser Handbuch der Spectroscopie 1, 513). In this arrangement the slit is placed at (or near) the focus of the lens and the dispersing system (in this case the grating) is placed on the other side of the lens in such a manner that the dispersed light returns through the lens which focuses it near the slit, as illustrated in Fig. 25, which represents a vertical section through the middle of the spectrograph and mountings. *S* is the slit, *L* the lens, placed at its focal distance from the slit and *G* is the reflecting grating placed just behind the lens *L*, and tilted so that its ruled lines are parallel to the slit. The beam of light to be examined passes through *S* spreading out to fill *L*, which renders it parallel before it reaches *G*, which disperses it and reflects or diffracts it back through *L*. By tilting the top of the grating slightly towards the slit the diffracted light is made to pass back through the lens which focuses it below the slit where it may be examined with an eye-piece or photographed in the plate-holder (*C*). By rotating *G* about a vertical axis on either side of the normal, the different parts of the different orders of spectra are diffracted back through the lens *L*, and by sliding the lens forward or backward the light of the different wave-lengths may be focussed sharply at *C*.

*(b) Mountings.*

The two tilting movements of the grating mentioned in (a) were provided in the cell of the grating by the John A. Brashear Co., from whom it was purchased. The forward tilt is given by screw *J* and suitable springs pressing against the back of the grating; and a screw placed on the side gives the means for adjusting the lines of the grating parallel to the slit. The grating in the cell rests on the stand *G'*, the axis of which fits into a cylindrical socket in the bottom of

the end, *B*, of the spectrograph, and by turning a handle *K''* (Fig. 26), attached to a worm which works in the toothed sector, *K*, which is attached rigidly to the axis of *G'*, the grating may be rotated about this axis which passes through the centre of the plane of the grating, thus reflecting any desired part of the spectrum of any order through the lens to *C*. By means of the vernier-pointer, *V*, readings to tenths of a degree may be made on the graduated arc *E* and a record of these readings with the corresponding wave-lengths of the spectra reflected to *C* is kept, so that by turning *K''* until *V* points to the proper angle, any desired wave-length may be reflected to the centre of *C* and the grating may be clamped in this position by tightening the screw-clamp *K'*. The lens may be shifted and clamped at any focus by means of the handle *H*, and the position of the pointer *F* is read on a millimetre scale attached to the bottom of *B*, as shown in Fig. 26. Ordinarily the side represented in Fig. 26 is facing downwards and a mirror is placed below the scale and the arc so that the reading may be made conveniently. In addition to these movements of the grating and lens, the mountings permit of rotation of the spectrograph as a whole about its axis, *i.e.*, about the line joining the centre of the slit and the centre of the lens. This idea was suggested by Mr. Plaskett (Report Chief Astronomer for the year ending March 31, 1907, p. 58) and employed by Newall (Monthly Notices 68, 7, Nov., 1907), and used also in the spectrograph mounted vertically and used with the vertical telescope of the Mount Wilson Solar Observatory. It facilitates the study of the rotation of the sun, by enabling the observer to reflect the limbs of the sun at opposite ends of any diameter always tangentially to the slit, as described in detail under (c), in Fig. 25. *A* and *B* are the two ends resting on the supports *A'* and *B'* which rest on the cement piers *P* and *P''* built on the cement floor. The end *A* is of half-inch cast brass. It has a V-groove running around its circular rim into which the semi-circular cast-iron support *A'* is bevelled to fit. The back of *A* is a rectangular box 3 in. by 11 in. by 14 in., over which the wooden box *O* is tightly screwed and clamped. The axis of *B*, which is of cast-iron, rests in a cylindrical bearing in the brass support *B'*. The box on *B* projects 3 in. on top and 16 in. on the sides and bottom to give good support for the lens and grating and to provide a surface to which the box *O* is screwed tightly. The bottom of *B* is milled smooth to give easy bearings for the grating and lens mountings. The box *O* is painted black on the inside and is provided with diaphragms, *M*, to prevent as much as possible the diffused light reflected from the lens and grating from striking the photographic plate in the holder, *C*. There is a hinged door, *D*, just above the grating and lens so that these may be conveniently reached.

The spectrograph thus rests at its two ends on the supports *A'* and *B'* on which it may be rotated about its axis. The rim of *A* is toothed (*T*, Fig. 25) and into these teeth fits a gear attached to *T'* (Fig. 27), which is supported in *A'* and which may be turned by means of the handle *T''* (Figs. 27 and 28). The circular face of *A* is graduated in degrees and by means of the vernier attached to *A'* the angle may be read to tenths of degrees. This is necessary in determining the 'East and West' line by allowing the image of the sun to drift across the face of *A* tangentially to some arbitrary line on *A*. From this angle read on the vernier, the position of the diameter of the sun's disc which lies in the plane of the sun's equator, is easily found since the inclination of these two lines to each other at any time is known, and hence the arbitrary line on *A* may be made parallel to any required diameter of the sun's image.

The mountings were constructed by the Victoria Foundry Co. from designs made in accordance with the suggestions of Mr. Plaskett who supervised the construction of the spectrograph. The mechanisms for rotating the grating and the spectrograph were skillfully constructed by Messrs. Mackay and Lucas.

#### (c) Slit-Attachment.

The slit-attachment is shown in Fig. 27. It was designed by Mr. Plaskett and made by the John A. Brashear Co., *a*, *b*, *c*, *d* are 45° reflecting prisms mounted on

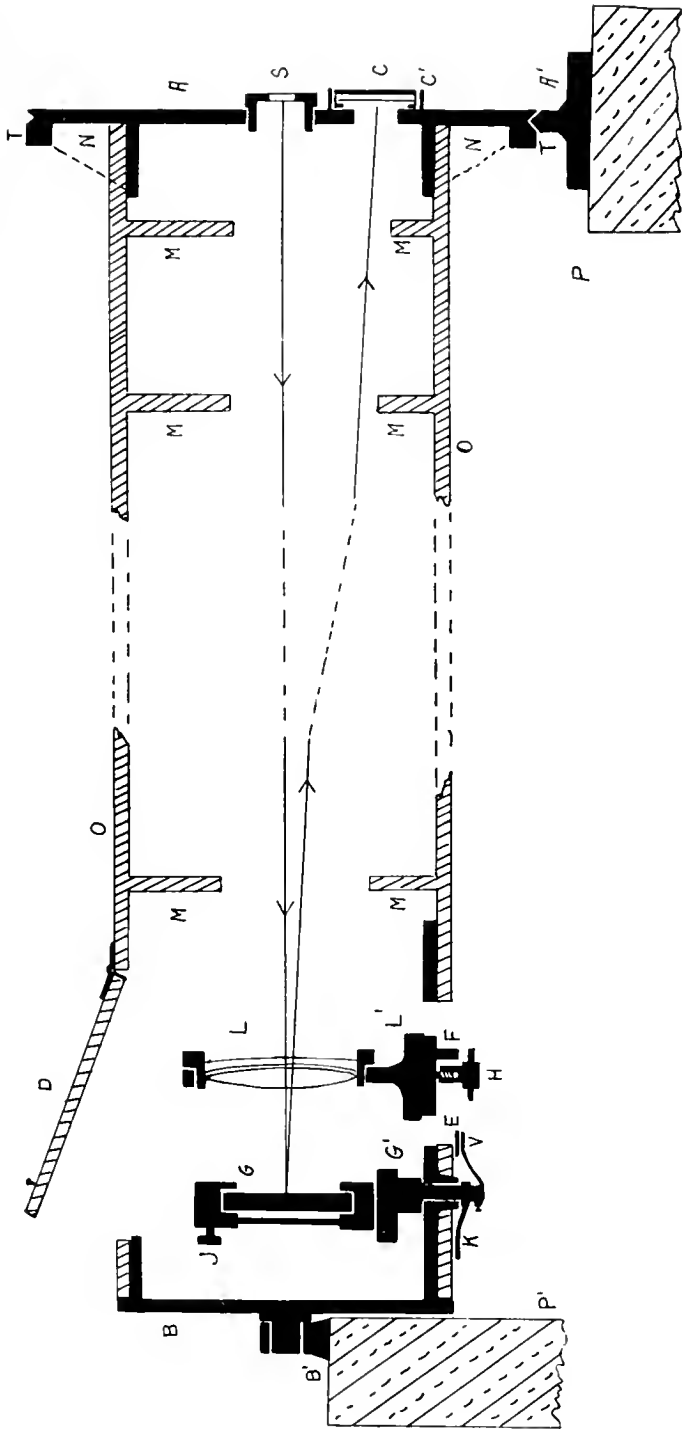


FIG. 25. Solar Spectrograph.





FIG. 26.—Rear end of Solar Spectrograph.



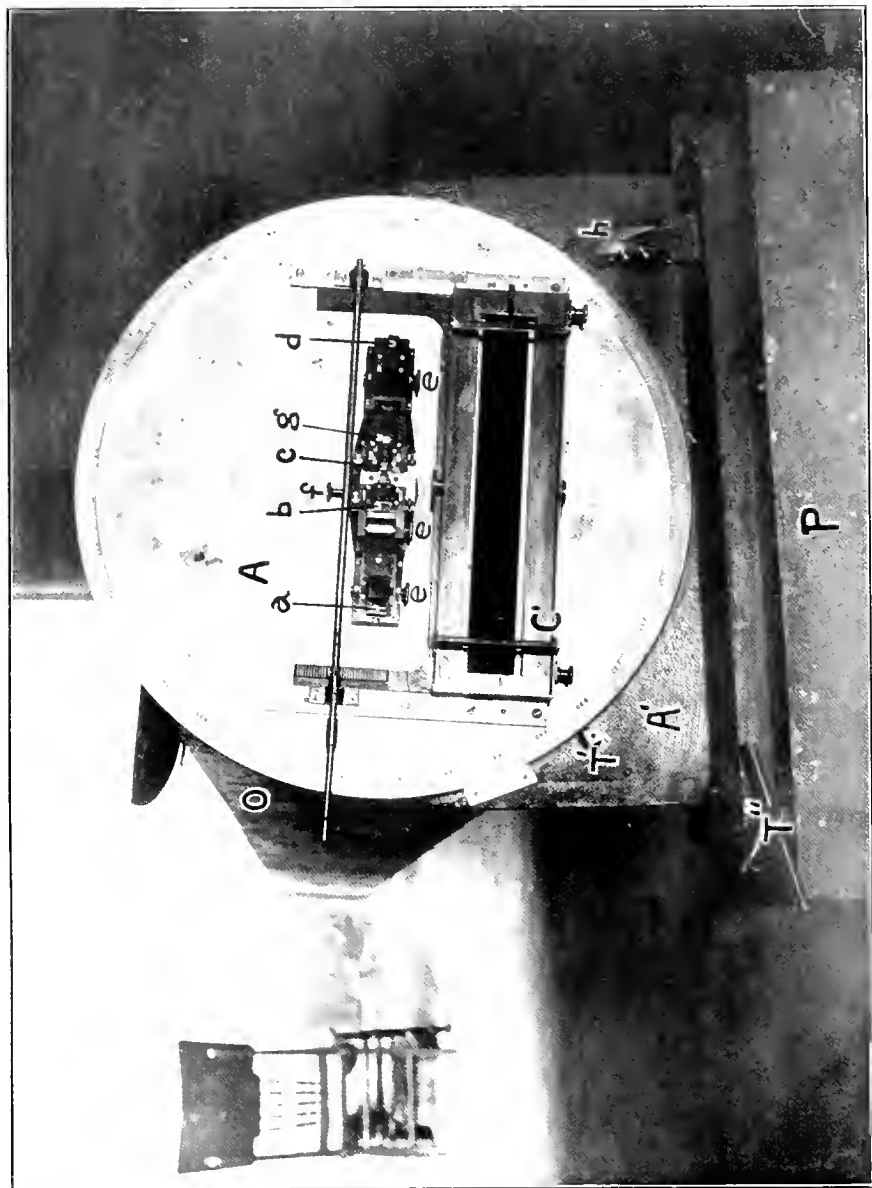


FIG. 27.—Slit Mechanism of Solar Spectrograph.





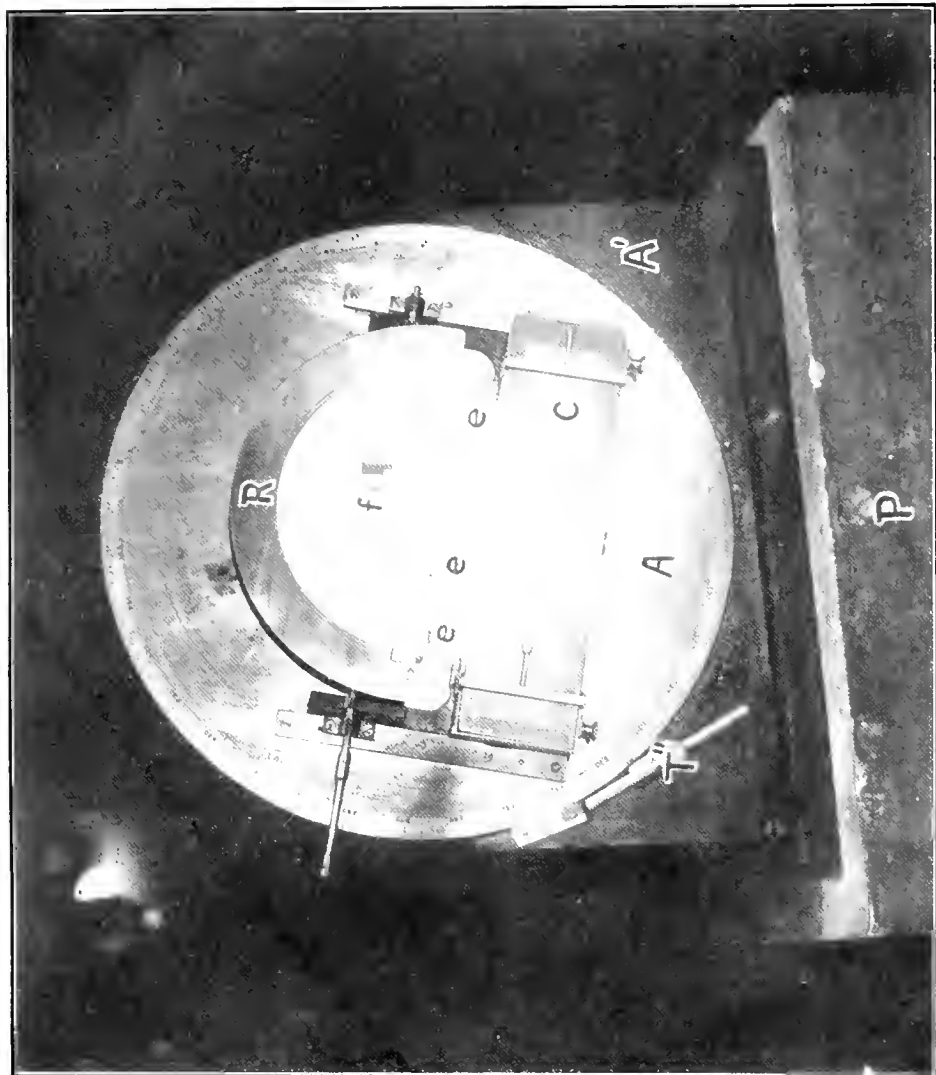


FIG. 28 - Front End of Solar Spectrograph.



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brass plates which are supplied with racks and pinions *e, e, e*. When the sun's image is placed concentric with the circular front of the spectrograph, the prism *d* is moved to take the light from any desired point near the sun's east limb and reflects it to the prism *c*, which directs it down through the slit to the lens and grating. In a similar way the larger prism, *a*, reflects to the west limb through the prism *b*, whose tapering ends form a V-shaped space into which the tapering end of *c* fits closely, so that the spectrum from the east limb is placed closely between two strips of the spectrum from the west limb. The widths of these strips may be varied by moving the plate holding the prisms *b* and *c* back and forth, and by means of two little slides placed directly over the ends of the slit. When desired the shutter, *f*, may be used to keep the light passing through the slit from reaching the lens. In place of the plate bearing the prisms *b* and *c*, the attachment, *h*, may be used and by means of two adjustable screws which serve as stops between which it may be shifted so that two spectra of any desired widths may be taken in succession, the one being placed between two strips of the other, the V-shaped openings and the V-shaped slides providing the means for adjusting the widths of the strips. The prism arrangement is intended for obtaining plates for measuring the rotation of the sun or for any investigations where it is desirable to take the spectra simultaneously, while the attachment, *h*, is designed for taking spectra in succession, and of course the time of an exposure will be less in using it than in using the prisms which diminish the intensity of the light considerably.

*(d) Camera and Plate-holders.*

The plate-holders are made to take a 2.5 in. x 12 in. plate, a hinged back with three springs pressing the back of the plate at its edges holding the plate firmly in place without danger of bending it. The plate-holder, *C*, Fig. 28, is slid into the frame *C'*, Fig. 27, and clamped, as shown in Fig. 28. The frame *C'* can be raised or lowered by rack and pinion as shown, so that several strips of spectra may be put side by side on the same plate, and spaced as desired by reference to the millimetre scale on the right hand side. The plate-holder fits over a 1.5 in. opening in *A*, Fig. 27. The frame *C'* may be tilted slightly so that the plane of the photographic plate may be made to follow more closely the focal surface of the lens.

*(e) Guide-plate for the Sun's Image.*

In Fig. 28 is shown the guide-plate *R*, screwed tightly over the slit-attachment. *R* has a number of concentric circles and a diameter scratched on its surface and blackened so as to be easily visible. These circles are concentric with the circular front of the end-piece *A*. The figure shows the sun's image placed concentric with these circles. At each end of the diameter of these circles is a small rectangular opening, back of which is a little slotted silver-plated shutter which runs in bevelled slides. These shutters may be adjusted by means of the millimetre scales on the edges of the two rectangular openings, so that the slots are tangential to the same circle whose diameter is read off directly, the distance between the nearest ends of the rectangular openings being 200 mm. In the same manner the diameter of the solar image is measured. Back of these slots the prisms are adjusted to give the maximum brightness in the light reflected from the grating, and thus the spectrum from a point in the image near one limit may be placed between two strips of the spectrum from a part of the image at the other end of the diameter. To get any desired latitude on the sun's disc, the image is allowed to drift across the guide-plate tangentially to the diameter—the arbitrary line mentioned above—scratched on the plate and the vernier reading taken of the angle corresponding to this 'east and west line' which makes a known angle at any time with the sun's equator. The handle *T''* is then turned to place the diameter in the desired position. One slit will thus be placed at a certain latitude north of the

sun's equator and the other at the same latitude south of the equator, and the displacement of the spectral lines resulting therefrom will give a measure of the rotation of the sun in this latitude by turning  $T''$  so that the slits are placed at the same latitude, but on the opposite sides of the equator to those of the former position the same displacement should result if: (1) the sun's equator has been accurately determined, (2) the image in both cases is concentric with the circles on the guide-plate, and (3) the rotation of the sun is the same for the same latitude in both hemispheres. Taking the mean of the two measures from plates taken in succession would eliminate most of the errors introduced.

#### SOME RESULTS.

The spectrograph was mounted in August, 1908. The cement piers,  $P$ ,  $P'$  (Figs. 26, 27, 28), are made so as to make the axis of the spectrograph coincident with the axis of the concave mirror in the cecostat house, when the image from it is placed in the middle of the face,  $A$ , of the spectrograph,  $P$  being a few inches higher than  $P'$ , giving the proper inclination (about  $3\frac{1}{2}^\circ$ ). The spectrograph was adjusted and numerous test photographs were taken in the various parts from  $\lambda 3800$  to  $\lambda 6000$ . To keep the light reflected back from the surfaces of the lenses from striking the photographic plate the ordinary method of putting a strip across the lens, parallel to the plate, was tried; also, in some tests, the lens was tilted forward so as to throw the reflected light below the photographic plate. This latter method does not alter the character of the lines very much and possesses the advantage of doing away with the strip which masks the central part of the grating and lens. It was soon found that the character of the spectral lines in the different orders from either the left or right inclinations of the grating was not as good as desired. By directly reflected light the grating appears to have three areas of different reflecting powers and it was found that the spectra from these areas did not harmonize. The best spectra were obtained by masking the two smaller areas and using the remaining strip which constituted the right three-fifths of the grating. Even from this part of the grating the spectral lines are poor. In the first and second orders the spectra from the grating tilted to the right are much more intense than those obtained when the grating is tilted to the left, while the reverse is the case in the third order, and furthermore the lines are sharper when the grating is tilted to the left. Consequently the rotation plates obtained were made with the grating tilted to the left and the left two-fifths of the grating masked together with the central strip placed over the face of the lens to cut off the reflected light. The focal curves, for left and right inclinations of the grating were obtained in the first three and part of the fourth orders, for the whole grating with the central strip masked. These are plotted in Fig. 29, the dotted lines being the photographically determined curves and the continuous lines, those visually determined. It will be seen that the locus of the foci for any wave-length in the different orders, instead of being a straight line of constant focus, is a curve (nearly a straight line) of varying focus. This is very likely due to the character of the reflecting surfaces between the scratches on the grating, for it may be assumed that the diamond scratching-point distorted the strips between the scratches in such a way as to make one side of the surface slightly convex and the other slightly concave, as might easily happen since on one side of the diamond-point the speculum is scratched or furrowed, while on the other side it is not. At any rate the grating is not what it should be for the work planned for this spectrograph. This work must necessarily deal with the exact positions and character of the spectral lines and any large or small changes in these. It is chiefly the minute changes that are of interest at present in solar investigations, and the very best possible definition of the spectrum lines is required for a satisfactory measurement of these changes. It is hoped that a new grating of first quality may soon be secured, as such is necessary to yield satisfactory results. Everything else is now in readiness for the careful study of solar problems.

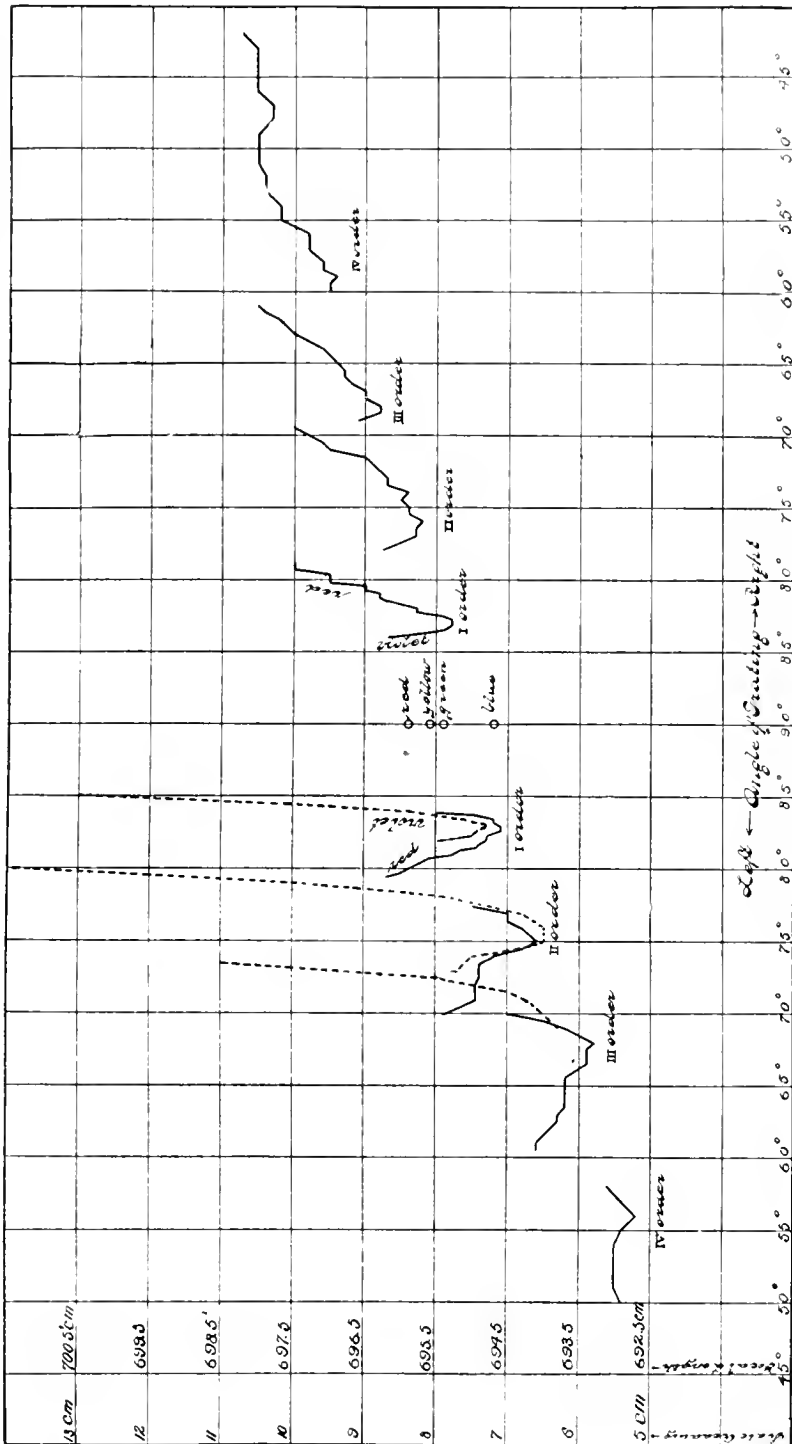


Fig. 29 Focal Curves of Solar Spectrograph.



4250

4240

4230

4220

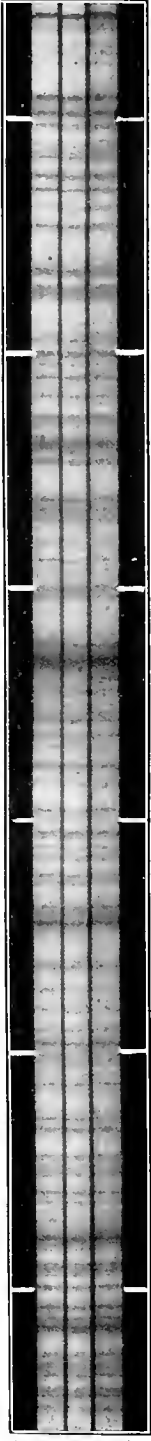
4210

$\lambda$  4200

W

E

W



H

K

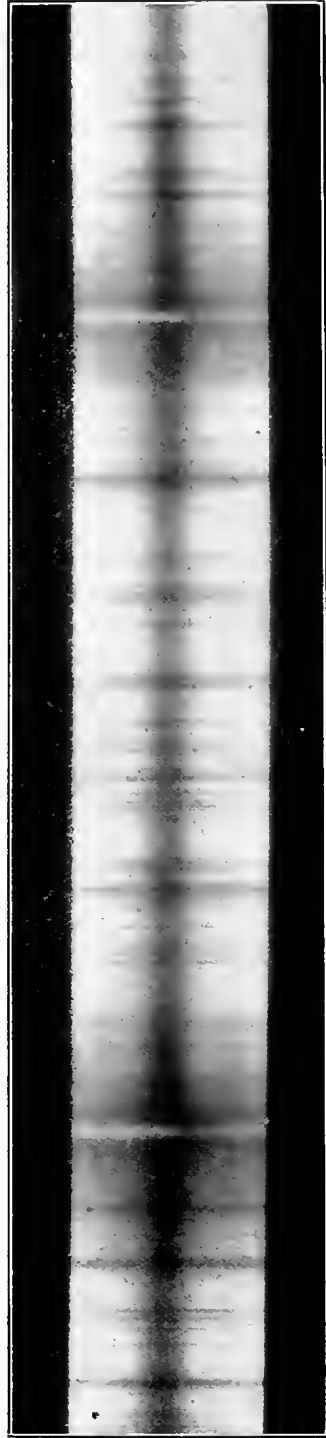


FIG. 30.—Part of Rotation Plate L 413. Scale of the original, 1 A. U. = 1.115 mm.  
Part of sum-spot Plate, L 405, showing emission in K and H. Scale of the original 1 A. U. = 1.11 mm.





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In addition to rotation-plates, plates of the sun spot spectra were obtained whenever the conditions were suitable. Samples of both are shown in Fig. 30. In the following table the measurements of a sample rotation-plate (L 413) are given. In taking these plates long exposures (10 or 12 minutes in the third order near 4300) were necessary owing to the fact that a very small area of the grating was used. During this interval the sun's image would become blurred and distorted, thus allowing light from different points on the sun's surface to pass through the slits. The poor values in the following table are probably partially due to this cause and partially also to aberrations produced by some of the curious properties of the grating and to the very poorly defined lines produced. Many of the lines were so poor that measurements of them were not made and many of the finer lines were spread out and weakened so as to be almost invisible. It is hoped that the new grating will remedy these defects.

Measurements of plate L 413,  $0^{\circ}.0$ , slits 226mm. apart, diameter of the sun 232 mm. :—

| $\lambda$ | Mean of 5<br>mm. readings<br>middle strip | Mean of 5<br>mm. readings<br>lower strip. | Mean of 5<br>mm. readings<br>upper strip. | Mean<br>difference. | $2\lambda$ | Velocity<br>km. per sec. |
|-----------|---|---|---|---------------------|------------|--------------------------|
| 4136.678  | 2.9828                                    | 3.0314                                    | 3.0430                                    | 0.0544              | 0.0488     | 1.77                     |
| 4137.156  | 3.5233                                    | 3.5650                                    | 3.5931                                    | .557                | .499       | 1.81                     |
| 4140.089  | 6.7876                                    | 6.8342                                    | 6.8411                                    | .500                | .448       | 1.62                     |
| 4147.836  | 15.4109                                   | 15.4623                                   | 15.4711                                   | .558                | .500       | 1.81                     |
| 4149.533  | 17.2990                                   | 17.3517                                   | 17.3520                                   | .529                | .474       | 1.71                     |
| 4150.411  | 18.2774                                   | 18.3256                                   | 18.3411                                   | .513                | .460       | 1.66                     |
| 4154.071  | 22.5768                                   | 22.6215                                   | 22.6324                                   | .502                | .450       | 1.62                     |
| 4154.667  | 23.0205                                   | 23.0724                                   | 23.0828                                   | .571                | .512       | 1.85                     |
| 4154.976  | 23.3789                                   | 23.4309                                   | 23.4333                                   | .532                | .477       | 1.72                     |
| 4157.948  | 26.6898                                   | 26.7408                                   | 26.7492                                   | .452                | .405       | 1.46                     |
| 4157.948  | 26.6868                                   | 26.7431                                   | 26.7558                                   | .627                | .562       | 2.03                     |
| 4158.959  | 27.8144                                   | 27.8550                                   | 27.8718                                   | .490                | .439       | 1.58                     |
| 4163.818  | 33.2268                                   | 33.2824                                   | 33.2919                                   | .604                | .542       | 1.95                     |
| 4169.110  | 39.1097                                   | 39.1550                                   | 39.1763                                   | .560                | .502       | 1.81                     |
| 4171.068  | 41.2803                                   | 41.3317                                   | 41.3462                                   | .587                | .526       | 1.89                     |
| 4174.095  | 44.6767                                   | 44.7188                                   | 44.7331                                   | .489                | .438       | 1.57                     |
| 4175.806  | 46.6005                                   | 46.6480                                   | 46.6549                                   | .510                | .457       | 1.64                     |
| 4176.739  | 47.6361                                   | 47.6780                                   | 47.6990                                   | .524                | .470       | 1.69                     |
| 4179.025  | 50.1899                                   | 50.2346                                   | 50.2450                                   | .499                | .447       | 1.60                     |
| 4179.025  | 50.1928                                   | 50.2358                                   | 50.2405                                   | .454                | .407       | 1.47                     |
| 4181.919  | 53.4269                                   | 53.4799                                   | 53.4878                                   | .571                | .512       | 1.84                     |
| 4182.548  | 54.1376                                   | 54.1827                                   | 54.1958                                   | .517                | .463       | 1.66                     |
| 4187.204  | 59.3360                                   | 59.3872                                   | 59.3987                                   | .570                | .511       | 1.83                     |
| 4187.943  | 60.1723                                   | 60.2212                                   | 60.2388                                   | .577                | .517       | 1.85                     |
| 4187.943  | 60.1754                                   | 60.2208                                   | 60.2423                                   | .562                | .504       | 1.81                     |
| 4196.372  | 69.5688                                   | 69.6076                                   | 69.6247                                   | .474                | .425       | 1.52                     |
| 4199.267  | 72.7938                                   | 72.8540                                   | 72.8663                                   | .664                | .596       | 2.13                     |
| 4199.267  | 72.8065                                   | 72.8626                                   | 72.8720                                   | .608                | .545       | 1.95                     |
| 4201.089  | 74.8526                                   | 74.9020                                   | 74.9137                                   | .553                | .496       | 1.77                     |
| 4202.919  | 76.8960                                   | 76.9398                                   | 76.9492                                   | .485                | .434       | 1.55                     |
| 4203.730  | 77.8073                                   | 77.8667                                   | 77.8677                                   | .599                | .537       | 1.92                     |
| 4204.622  | 78.7510                                   | 78.8003                                   | 78.8116                                   | .550                | .493       | 1.76                     |
| 4207.291  | 81.7826                                   | 81.8279                                   | 81.8413                                   | .520                | .466       | 1.66                     |
| 4208.766  | 83.4393                                   | 83.4904                                   | 83.4972                                   | .545                | .488       | 1.74                     |
| 4213.812  | 89.0824                                   | 89.1385                                   | 89.1469                                   | .601                | .539       | 1.92                     |
| 4216.351  | 91.9678                                   | 91.9656                                   | 91.9685                                   | .593                | .532       | 1.89                     |
| 4220.509  | 96.5671                                   | 96.6150                                   | 96.6305                                   | .557                | .499       | 1.77                     |
| 4233.328  | 110.4159                                  | 110.4651                                  | 110.4745                                  | .539                | .483       | 1.71                     |
| 4236.112  | 113.1064                                  | 113.1574                                  | 113.1659                                  | .553                | .496       | 1.76                     |
| 4236.279  | 113.2910                                  | 113.3460                                  | 113.3567                                  | .604                | .542       | 1.92                     |
| 4236.279  | 113.2911                                  | 113.3482                                  | 113.3563                                  | .612                | .549       | 1.94                     |
| 4238.970  | 116.3636                                  | 116.4092                                  | 116.4177                                  | .499                | .447       | 1.58                     |
| 4246.966  | 126.2158                                  | 126.2723                                  | 126.2819                                  | .613                | .550       | 1.94                     |
| 4258.774  | 139.0965                                  | 139.1464                                  | 139.1514                                  | .524                | .470       | 1.66                     |
| 4265.418  | 147.6064                                  | 147.6630                                  | 147.6666                                  | .581                | .524       | 1.84                     |
| 4268.915  | 150.7909                                  | 150.8440                                  | 150.8464                                  | .543                | .487       | 1.71                     |
| 4271.325  | 153.4834                                  | 153.5426                                  | 153.5454                                  | .606                | .544       | 1.91                     |
| 4271.934  | 154.6638                                  | 154.7190                                  | 154.7275                                  | .595                | .533       | 1.87                     |

## Measurements of Plate L 413 (Continued).

| $\lambda$ | Mean of 5<br>mm. readings<br>middle strip | Mean of 5<br>mm. readings<br>lower strip | Mean of 5<br>mm. readings<br>upper strip. | Mean<br>difference. | $2\delta\lambda$ | Velocity<br>km. per sec. |
|-----------|---|--|---|---------------------|------------------|--------------------------|
| 4274.958  | 157.5602                                  | 157.6159                                 | 157.6230                                  | 0.0533              | 0.0478           | 1.68                     |
| 4279.643  | 162.8316                                  | 162.8856                                 | 162.8923                                  | .574                | .515             | 1.81                     |
| 4282.565  | 166.1090                                  | 166.1575                                 | 166.1650                                  | .523                | .469             | 1.64                     |
| 4283.169  | 166.7867                                  | 166.8456                                 | 166.8437                                  | .580                | .520             | 1.82                     |
| 4287.566  | 171.7201                                  | 171.7671                                 | 171.7684                                  | .477                | .427             | 1.49                     |
| 4288.310  | 172.5555                                  | 172.6182                                 | 172.6188                                  | .630                | .565             | 1.98                     |
| 4289.525  | 173.9153                                  | 173.9697                                 | 173.9714                                  | .553                | .496             | 1.73                     |
| 4289.885  | 174.3185                                  | 174.3698                                 | 174.3829                                  | .579                | .519             | 1.82                     |
| 4290.080  | 174.8803                                  | 174.9256                                 | 174.9400                                  | .525                | .475             | 1.66                     |
| 4390.377  | 175.0671                                  | 175.1180                                 | 175.1266                                  | .557                | .499             | 1.74                     |
| 4291.114  | 176.2785                                  | 176.3263                                 | 176.3375                                  | .534                | .479             | 1.67                     |
| 4295.333  | 181.0754                                  | 181.1309                                 | 181.1437                                  | .619                | .555             | 1.94                     |
| 4300.211  | 185.9150                                  | 185.9642                                 | 185.9754                                  | .548                | .491             | 1.71                     |
| 4300.211  | 184.7011                                  | 184.7533                                 | 184.7603                                  | .557                | .499             | 1.74                     |
| 4302.692  | 187.4850                                  | 187.5400                                 | 187.5453                                  | .577                | .517             | 1.80                     |
| 4312.462  | 200.4632                                  | 200.5002                                 | 200.5203                                  | .571                | .512             | 1.78                     |
| 4316.962  | 205.6104                                  | 205.6557                                 | 205.6737                                  | .543                | .487             | 1.69                     |
| 4320.907  | 207.9588                                  | 207.9978                                 | 207.9193                                  | .498                | .446             | 1.55                     |
| 4321.119  | 208.1885                                  | 208.2350                                 | 208.2553                                  | .567                | .508             | 1.76                     |
| 4331.811  | 220.2219                                  | 220.2719                                 | 220.2817                                  | .549                | .492             | 1.71                     |
| 4337.216  | 226.3078                                  | 226.3617                                 | 226.3729                                  | .595                | .533             | 1.85                     |
| 4338.084  | 227.2934                                  | 227.3348                                 | 227.3580                                  | .530                | .475             | 1.64                     |
| 4338.430  | 227.6796                                  | 227.7315                                 | 227.7403                                  | .563                | .505             | 1.75                     |
| 4339.617  | 229.0152                                  | 229.0619                                 | 229.0751                                  | .533                | .478             | 1.65                     |
| 4339.882  | 229.3068                                  | 229.3559                                 | 229.3787                                  | .605                | .542             | 1.87                     |
| 4343.861  | 233.7958                                  | 233.8477                                 | 233.8647                                  | .604                | .542             | 1.87                     |
| 4344.451  | 234.4621                                  | 234.5066                                 | 234.5309                                  | .567                | .508             | 1.74                     |
| 4344.670  | 234.7022                                  | 234.7509                                 | 234.7669                                  | .567                | .508             | 1.75                     |
| 4344.670  | 234.7023                                  | 234.7510                                 | 234.7679                                  | .572                | .513             | 1.77                     |
| 4351.216  | 242.0735                                  | 242.1259                                 | 242.1400                                  | .595                | .533             | 1.84                     |
| 4351.216  | 242.0719                                  | 242.1223                                 | 242.1343                                  | .564                | .506             | 1.74                     |
|           |   |  |   |                     | Mean....         | 1.77                     |

The scale, which is practically constant over the whole plate, is 1 A. U. = 1.115 mm., hence  $2\delta\lambda = \frac{\text{mean difference}}{1.115}$ . The velocity is  $\frac{\delta\lambda}{\lambda}$  (Velocity of light) =  $299860 \frac{\delta\lambda}{\lambda}$  km. per second. Heliographic latitude of the centre of the sun's disc was  $6^\circ 26'$  when plate L 413 was taken, consequently the velocity at the equator, as determined by this plate is  $\frac{232}{226} \cdot 1.77 \cdot \frac{1}{\cos 6^\circ 26'} = 1.83$  km. per second. This value is the linear velocity of the sun's limit at the equator, as measured, and will evidently give the synodic period of the rotation, the value for which is 1.86, as given by Adams. To reduce to the sidereal period requires the addition of 0.14km., making the velocity 1.97km. The generally accepted value is approximately 2.05km. per second, and the deficiency in the present case may be safely ascribed to errors introduced by the grating.

APPENDIX D.

DOUBLE STAR MEASURES. PHOTOGRAPHS OF COMET MOREHOUSE.  
 OCCULTATIONS OF STARS BY THE MOON. FIELD INSTRUMENTS.  
 ABERRATIONS OF THE STELLAR CAMERA OBJECTIVE.

R. M. MOTHERWELL.

DOUBLE STAR MEASURES.

Three half nights each week have been devoted to micrometer and photographic work, including the series of tests made on the camera objective. Micrometer work has consisted principally of the determination of the position angles and distances of visual double stars, the working list being prepared from Burnham's Catalogue of Double Stars. An endeavour is being made to measure only those which have not been measured for some time or whose motion is such as to require frequent measurements.

The flar micrometer used, is the Warner and Swasey type, and it has been found rather unsatisfactory in the determination of position angles owing to there being no quick-motion screw for moving the position circle. A self-registering attachment would be a great improvement as the present arrangement requires the frequent use of a hand-lamp which dazzles the eye. Considerable difficulty has also been experienced in keeping the eye-piece clear of frost in the winter, each setting of the micrometer-head or position-circle requiring several clearings of the glass.

Following are the measures made during the past year, each measure being the mean of eight settings for position angle and four double-distance measures:—

| Star No.  | Date.    | Position Angle. | Distance.  | Star No.    | Date.    | Position Angle. | Distance. |
|-----------|----------|-----------------|------------|-------------|----------|-----------------|-----------|
| 151.....  | 1908 786 | 279 0           | 1 34       | 7117.....   | 1908 464 | 298 2           | Cloudy.   |
| 269.....  | 1908 765 | 113 9           | 5 78       | 7318.....   | 1908 317 | 184 3           | 3 81      |
| 1427..... | 1908 921 | 313 9           | 3 28       | .....       | 1908 575 | 186 8           | 4 01      |
| 1750..... | 1908 921 | 249 1           | 17 24      | 7429 5..... | 1909 429 | 252 9           | 9 39      |
| 2040..... | 1908 921 | 218 8           | 4 21       | 7450.....   | 1908 575 | 15 2            | 8 70      |
| 2043..... | 1908 921 | 328 5           | .....      | .....       | 1908 617 | 14 3            | 9 21      |
| 2536..... | 1908 996 | 305 3           | 2 73       | .....       | 1908 631 | 14 0            | 9 53      |
| 3398..... | 1908 996 | 6 4             | .....      | .....       | 1909 412 | 14 9            | 8 91      |
| 4452..... | 1909 341 | 43 3            | 2 60       | .....       | 1909 429 | 13 9            | 9 32      |
| 4530..... | 1909 086 | 139 6           | 6 12       | 7451.....   | 1908 317 | 255 4           | 16 64     |
| 4890..... | 1908 247 | 196 9           | 5 14       | .....       | 1908 464 | 254 1           | 17 11     |
| .....     | 1909 086 | 196 7           | 4 88       | .....       | 1908 575 | 254 8           | 16 57     |
| .....     | 1909 303 | 197 0           | 5 11       | .....       | 1908 617 | 256 0           | 16 17     |
| 5011..... | 1908 247 | 45 5            | 1 88       | .....       | 1908 631 | 254 6           | 16 65     |
| 5014..... | 1909 202 | 235 9           | 3 50       | 7458.....   | 1908 575 | 288 9           | 3 21      |
| .....     | 1909 303 | 234 0           | 3 39       | 7604.....   | 1908 464 | 211 9           | 17 12     |
| .....     | 1909 341 | 235 5           | 3 40       | .....       | 1908 497 | 211 9           | 16 89     |
| 5125..... | 1908 304 | 146 5           | 3 43       | .....       | 1908 575 | 214 0           | 16 59     |
| 5319..... | 1908 394 | 176 9           | 2 50       | 7642.....   | 1908 575 | 89 8            | 1 77      |
| .....     | 1908 426 | 177 3           | 2 78       | 7915.....   | 1908 439 | 18 2            | 5 03      |
| 5337..... | 1908 977 | 295 2           | 30 78      | .....       | 1908 492 | 20 0            | 5 38      |
| .....     | 1909 183 | 294 4           | 31 50      | .....       | 1908 617 | 18 4            | 5 48      |
| .....     | 1909 202 | 294 8           | 31 89      | 5388.....   | 1908 247 | 117 4           | 3 88      |
| .....     | 1909 399 | 291 3           | 31 09      | .....       | 1908 426 | 115 5           | 3 43      |
| 6780..... | 1909 183 | 353 4           | Too frosty | .....       | 1909 183 | 114 1           | 3 89      |
| 7065..... | 1909 183 | 111 1           | "          | .....       | 1909 399 | 116 4           | 3 82      |

| Star No. | Date.    | Position Angle. | Distance. | Star No. | Date.    | Position Angle. | Distance. |
|----------|----------|-----------------|-----------|----------|----------|-----------------|-----------|
| 5126     | 1908 247 | 68.6            | 3.05      |          | 1908 641 | 338.7           | 27.47     |
|          | 1909 303 | 68.1            | 3.50      |          | 1908 765 | 339.3           | 26.90     |
|          | 1909 399 | 66.5            | 3.27      | 9034     | 1908 541 | 51.9            | 7.84      |
| 5705     | 1909 303 | 32.2            | 3.37      |          | 1908 581 | 50.5            | 8.50      |
| 5809     | 1908 977 | 27.6            | 24.86     | 9037     | 1908 541 | 7.41            | 5.90      |
|          | 1909 078 | 28.0            | 25.17     |          | 1908 581 | 7.33            | 5.88      |
|          | 1909 086 | 30.7            | 24.90     |          | 1908 641 | 7.24            | 5.68      |
|          | 1909 202 | 27.6            | 24.89     |          | 1908 765 | 7.12            | 5.91      |
|          | 1909 303 | 28.3            | 25.33     | 9167     | 1908 541 | 154.8           | 0.84      |
| 6030     | 1908 426 | 308.5           | 2.80      |          | 1908 613 | 154.5           | 0.89      |
| 6033     | 1908 426 | 108.8           | 6.28      | 9604     | 1908 541 | 9.7             | 2.81      |
|          | 1909 078 | 107.8           | 5.72      |          | 1908 613 | 10.5            | 2.75      |
|          | 1909 202 | 106.8           | 6.06      | 9693     | 1908 492 | 138.6           | 4.07      |
|          | 1909 303 | 106.7           | 6.57      |          | 1908 522 | 138.0           | 3.74      |
| 6035     | 1909 078 | 178.9           | 16.32     |          | 1908 575 | 138.3           |           |
|          | 1909 086 | 181.7           | 16.10     |          | 1908 581 | 138.6           | 4.01      |
|          | 1909 183 | 179.3           | 16.50     |          | 1908 613 | 137.8           | 3.93      |
|          | 1909 399 | 179.4           | 16.41     | 9905     | 1908 600 | 271.1           |           |
| 6211     | 1908 426 | 359.2           | 2.60      | 9969     | 1908 600 | 155.7           | Cloudy.   |
| 6386     | 1909 360 | 119.0           | 2.99      | 9977     | 1908 641 | 170.1           | 4.31      |
| 7927     | 1908 617 | 127.0           | 33.08     |          | 1908 765 | 171.0           | 4.31      |
|          | 1908 631 | 125.3           | 33.24     |          | 1908 786 | 171.8           | 3.50      |
|          | 1909 429 | 126.5           | 33.21     | 10061    | 1908 765 | 185.3           | 7.18      |
| 7930     | 1908 617 | 180.8           | 24.94     | 10072    | 1908 613 | 212.2           | Hazy.     |
|          | 1908 631 | 180.5           | 24.93     | 10305    | 1908 522 | 74.2            | "         |
| 8003     | 1908 309 | 312.4           | 4.15      | 10385    | 1908 581 | 111.0           | 3.51      |
|          | 1908 445 | 313.3           | 4.17      | 10685    | 1908 522 | 164.6           | 1.89      |
| 8082     | 1908 309 | 22.8            | 8.11      | 10709    | 1908 613 | 158.3           | 3.39      |
|          | 1908 426 | 22.6            | 7.98      | 10742    | 1908 613 | 349.2           | 22.90     |
|          | 1908 439 | 25.4            | 7.91      |          | 1908 765 | 351.5           | 23.89     |
|          | 1908 445 | 24.4            | 7.95      | 10773    | 1908 522 | 309.3           | 3.37      |
| 8303     | 1908 309 | 258.5           | 2.67      |          | 1908 541 | 307.9           |           |
|          | 1908 445 | 258.7           |           |          | 1908 581 | 307.5           | 3.71      |
|          | 1908 617 | 259.7           | 2.53      |          | 1908 786 | 307.8           | 3.44      |
| 8364     | 1908 617 | 81.6            | 2.71      |          | 1908 805 | 308.8           | 3.18      |
|          | 1908 746 | 78.2            | 2.87      | 10901    | 1908 613 | 112.6           | 5.68      |
|          | 1908 765 | 79.4            | 2.70      |          | 1908 641 | 112.0           | 5.60      |
|          | 1909 429 | 78.2            | 3.09      | 12043    | 1908 765 | 34.3            | 5.91      |
| 8384     | 1908 624 | 79.0            | 1.49      | 12753    | 1908 765 | 160.1           | 3.09      |
| 8404     | 1908 631 | 338.4           | 27.15     |          |          |                 |           |

COMET 1908C (MOREHOUSE).

This comet was visible for over three months, but dense smoke and unusually cloudy weather prevented any attempt at obtaining an extensive series of photographs. Single exposures were made on seven different nights, with the Brashear Doublet attached to the equatorial telescope. A filar micrometer was used in guiding and was very satisfactory in preventing drifting but, owing to the smallness of its field, did not permit of the head of the comet being shifted appreciably from the centre of the camera field. Had it been possible to so shift the head, more of the tail would have been included in the photograph.

The following table gives the date and duration of each exposure:—

| Plate. | Eastern Standard Time. | Beginning of Exposure. | Duration. | Remarks.            |
|--------|------------------------|------------------------|-----------|---------------------|
|        | 1908,                  | h m                    | h m       |                     |
| 31     | October 16             | 6 45                   | 1 0       | Very smoky.         |
| 32     | " 19                   | 6 10                   | 1 5       | "                   |
| 33     | " 31                   | 7 25                   | 0 55      | Clear.              |
| 34     | November 1             | 7 15                   | 0 55      | Clear but unsteady. |
| 35     | " 13                   | 6 15                   | 1 0       | Very clear.         |
| 36     | " 26                   | 5 30                   | 1 25      | Clear, high wind.   |



FIG. 31 & 32 - Morehouse's Comet.



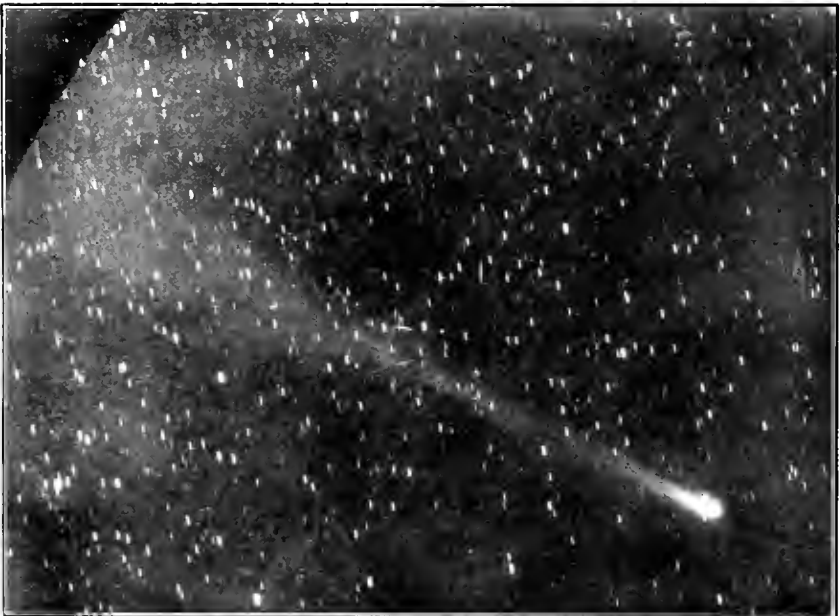
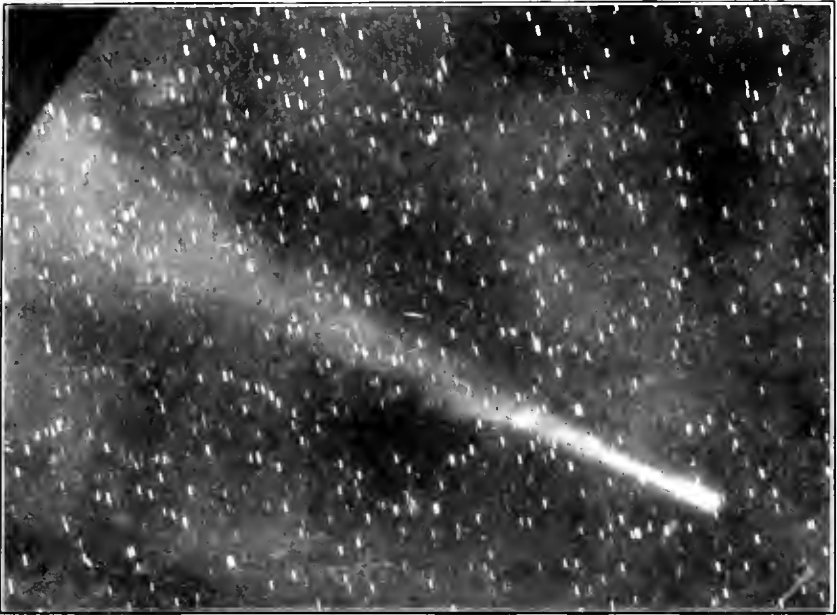


FIG. 33 & 34—Morchouse's Comet.





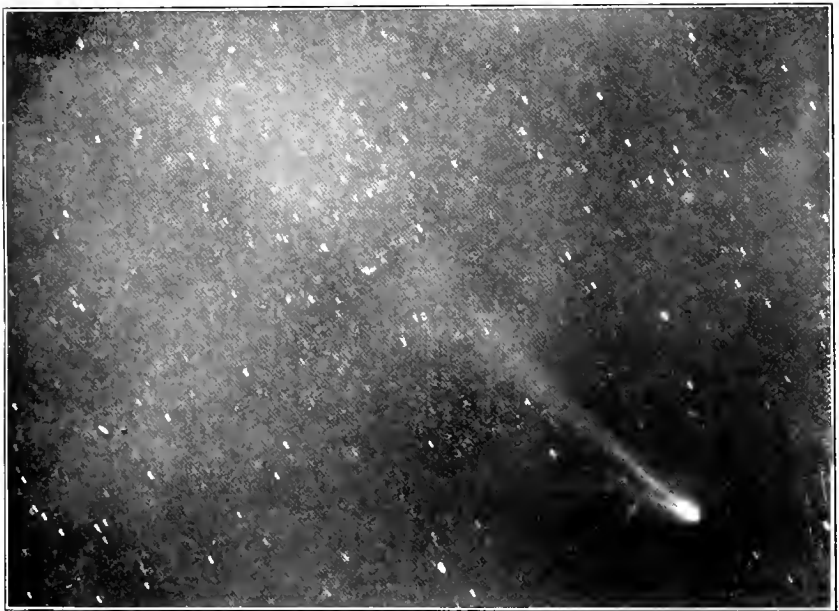
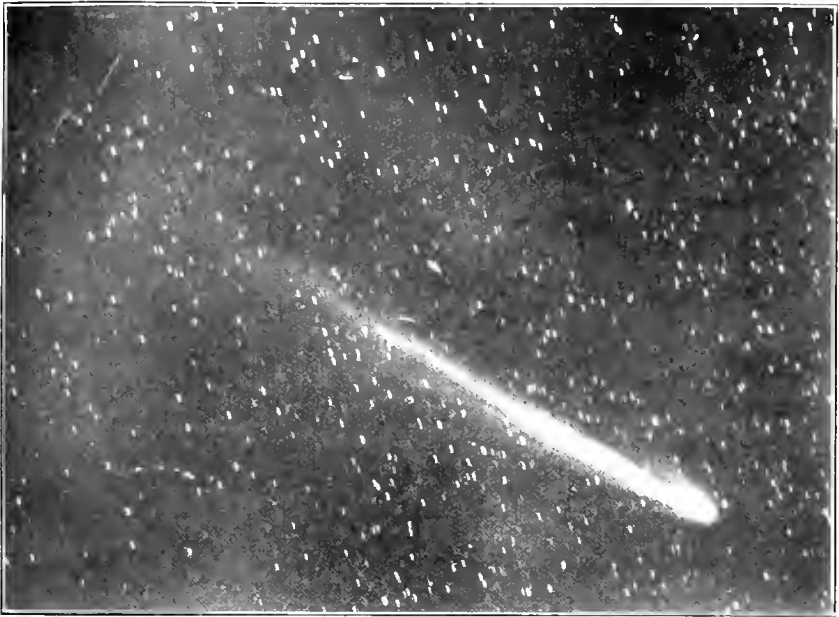


FIG. 35 & 36 - Morchouse's Comet.



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An exposure of one hour was made on October 20, but the smoke was too dense. In the course of the exposure the head of the comet passed over an eighth magnitude star without perceptibly dimming it.

Fig. 31. The dense smoke accounts for the faintness of this photograph, but still it is the most interesting one of the set, on account of the knots in the tail about one and a half degrees from the head. This portion seems to have separated from the head and drifted off while new matter has been given out. There has also probably been a motion southward on the part of this detached mass, greater than that of the comet as the new matter in the tail connects with the north side of the knots, while the southern part is altogether clear of the tail. The curved form of the central and southern portions of the detached mass is also worthy of notice. The new matter is connected to the head by a narrow neck and on either side rays extend back about 0.5 degrees.

Fig. 32. This photograph is even more faint than Fig. 31, but the head shows considerable detail. The new portion of the tail spoken of in Fig. 31 has apparently been forced back by the rays on either side, they being joined together now just back of the head. Although only three days have elapsed between these exposures we can readily see that, during this interval, the comet has been very active internally.

Figs. 33 and 34 indicate a continuation of this activity. Fig. 33 shows several distinct knots in the tail about one to one and a half degrees from the head. Beyond these the tail gradually widens out, being uniform on the north side but broken on the south side. Fig. 34, one day later, shows the same knots farther away from the head and more diffused. They seem to have been separated from the nucleus, the bright portion next to the head in Fig. 33 broadening out here into a fan-shaped tail. Beyond the knots the tail has widened slightly.

Fig. 35 shows a very bright tail extending out about two degrees with short rays on both sides of the head. As in Fig. 33 the north side of the tail is uniform, while the south side shows several offshoots. The comet was apparently in a very active state at this time, but thirteen days elapsed before I had an opportunity for another exposure, and Fig. 36 shows a much fainter and divided tail. Evidently the activity has become much less, the faintness of the tail being partly due to its division into two parts, but more particularly to a change in the conditions governing the state of the comet's head. Are these changes in appearance due to some internal state or are they due to changes in the surrounding medium?

While this set of photographs can lay no claim to completeness, it demonstrates clearly the necessity for frequent exposures at as close intervals as possible if we wish to know with any degree of accuracy the changes actually taking place. It also shows that these exposures should not be too long, otherwise one plate might be a combination of several phases.

No other comets were visible here in 1908, but several exposures were made toward the close of the year in search of Halley's comet. The end of July or the early part of August, 1909, should see the discovery of this famous celestial visitor. Photography will doubtless first reveal its presence and on account of this it is desirable that the stellar camera should be available for work every night. With the present mounting of the camera this means the suspending of all work with the equatorial at such times when the comet may be observed. This is much to be regretted as both the equatorial telescope and the camera are excellent instruments, and it is hoped that a separate mounting may be provided for the camera at an early date. Halley's comet will not return for at least seventy-five years, but every year brings with it new comets; so if our Dominion Observatory is to take a foremost place in the discovery and study of these strange visitors, the equipment necessary for camera work should be provided at once.

## OCCULTATIONS OF STARS BY THE MOON.

The observations of occultations have been made mostly with the 15-inch equatorial telescope as its superior mounting and clock-work render it much more satisfac-

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tory than the 4½-inch Cooke telescope. Predictions have been made by the graphical method of Wm. F. Rigge, but less than 10 per cent of the predicted occultations were observed owing to cloudy weather. Following are the observations:—

OCULTATIONS OF STARS BY THE MOON.

| Date.       | Phenomenon.    | Star.                   | Limb.   | G.M. Time of observation. |    |      |
|-------------|----------------|-------------------------|---------|---------------------------|----|------|
|             |                |                         |         | h.                        | m. | s.   |
| 1908.       |                |                         |         |                           |    |      |
| April 9.    | Disappearance. | γ Cancri.               | Dark.   | 6                         | 53 | 53·2 |
| " 13.       | "              | ν Virginis              | "       | 7                         | 2  | 55·6 |
|             | Reappearance.  | "                       | Bright. | 8                         | 8  | 36·5 |
| June 11.    | Disappearance. | σ <sup>1</sup> Libræ.   | Dark.   | 13                        | 44 | 23·3 |
| " 12.       | "              | μ <sup>2</sup> Scorpii. | "       | 11                        | 28 | 11·1 |
|             | Reappearance.  | "                       | Bright. | 12                        | 0  | 16·8 |
| October 13. | Disappearance. | η Tauri.                | "       | 16                        | 52 | 41·0 |
| November 1. | "              | γ Capricorni.           | Dark.   | 5                         | 30 | 1·8  |
| 1909.       |                |                         |         |                           |    |      |
| January 7.  | "              | γ Cancri.               | Bright. | 12                        | 19 | 15·8 |
| March 12    | "              | β <sup>1</sup> Scorpii. | "       | 16                        | 35 | 6·1  |
|             | Reappearance.  | "                       | Dark.   | 17                        | 25 | 37·8 |
|             | Disappearance. | 56B Scorpii.            | Bright. | 16                        | 35 | 59·7 |
|             | Reappearance.  | "                       | Dark.   | 17                        | 24 | 59·0 |
| March 14    | Disappearance. | 63 Ophiuchi.            | Bright. | 16                        | 12 | 3·1  |
|             | Reappearance.  | "                       | Dark.   | 17                        | 30 | 57·4 |

INSTRUMENTS USED ON THE BOUNDARY AND GEODETIC SURVEYS.

The instruments used on these surveys have all been carefully catalogued and stamped, an index system being used which shows the office number, description of instrument, price, date of receipt, name of maker, location and disposal of each instrument. A separate account is also kept of the instruments as taken out by each party in the spring, so that each man can readily see what instruments he is held responsible for.

Following is a list of the principal instruments used during the season of 1908:—

| Name of Instrument. | Number Used. | Name of Instrument. | Number Used. |
|---------------------|--------------|---------------------|--------------|
| Barometers.         | 20           | Heliotropes.        | 8            |
| Balances.           | 5            | Levels.             | 11           |
| Binoculars.         | 18           | Plane Tables.       | 5            |
| Cameras.            | 18           | Sextants.           | 2            |
| Chronometers.       | 14           | Tapes.              | 25           |
| Climometers.        | 4            | Telescopes.         | 9            |
| Compasses.          | 25           | Transits.           | 47           |

ABERRATION OF THE STELLAR CAMERA OBJECTIVE.

The stellar camera used in the Dominion Observatory, Ottawa, for photographing star clusters, nebulae, comets, or any other celestial objects covering a wide field, is fitted with a Brashear photographic doublet of 203mm. aperture and 1060·3mm. focus. The camera tube (Fig. 37) is bolted to the telescope tube opposite to its place of attachment to the declination axis. This method of mounting is rather unsatisfactory, however, as the telescope tube intercepts a large portion of the light on the west side of the plate.

The effective field has a diameter of about 11° 20', so the camera is well adapted in this respect to its work. The tube containing the objective is nickelled and moves freely in the main metal tube, the position of focus being adjusted by a rack and pinion with a clamp screw to hold it in the required position. This position is read on

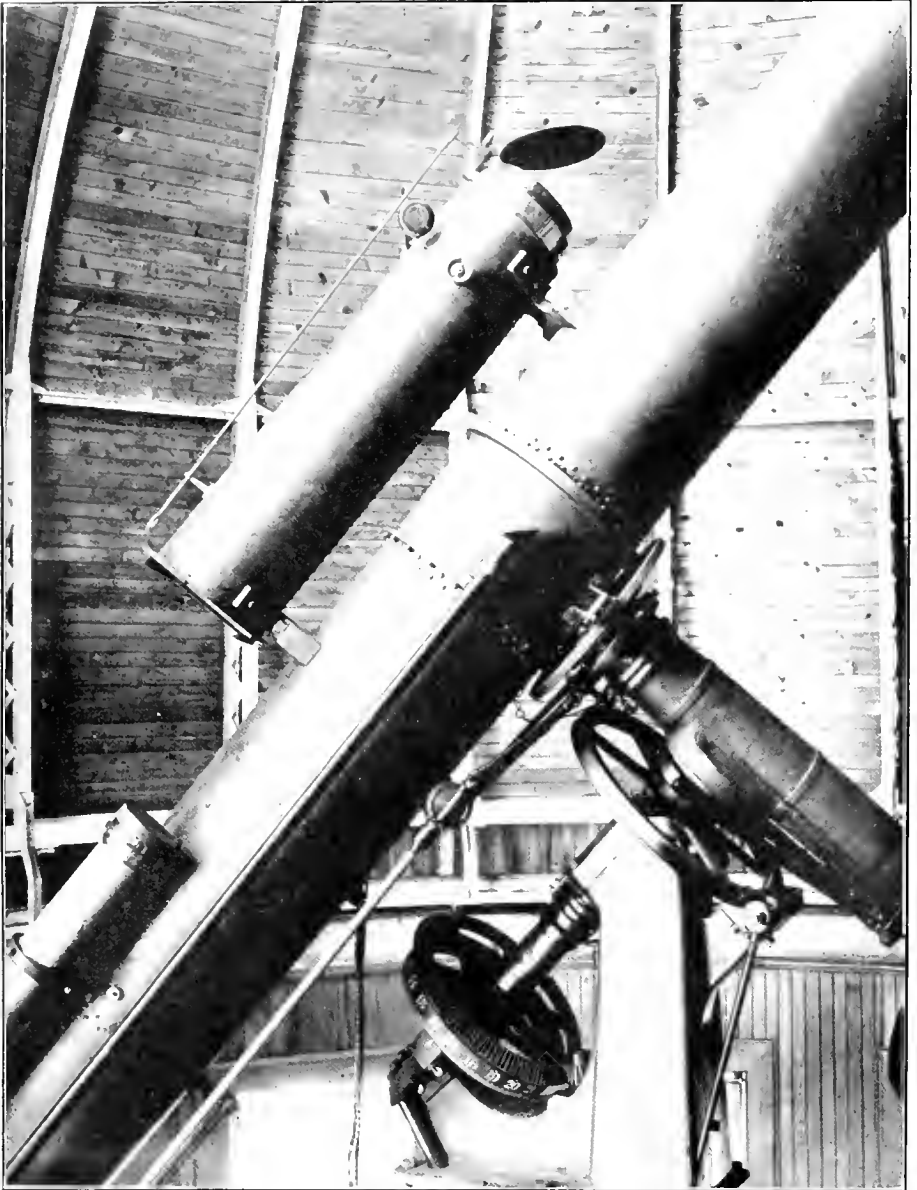


FIG. 37 Stellar Camera.



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a millimetre scale. A metal shutter covers the objective and the plates are held in a metal frame fitted with springs. When accurate guiding is required the micrometer wires in the telescope are used, the great focal length of the refractor, as compared with the camera, rendering the guiding a simple matter.

The following description of the lens is given by Dr. Brashear:—

‘The general construction is that which was first found by Petzval years ago, and has proven itself quite the best, where great angular aperture with sharp definition is required. The curves have been somewhat modified from our experience in the construction of other lenses—particularly those made for Dr. Max Wolf, of Heidelberg, Germany. It departs, however, from the ordinary practice of opticians in being corrected for short wave-lengths of light. This would be quite objectless in a camera which is to be used for portraits, but is not without moment in astronomical photography. The materials employed were specially chosen for their transparency, the flint being very light and the crown very white. The focal lengths of the front and rear combinations are in a ratio of about 7 to 12, while the focal length of the system is very nearly five times the aperture. The focal length we may find very slightly modified: indeed it is our custom to balance the inevitable zonal differences of magnification, which difficulty is found the most formidable to all constructors of astronomical photographic objectives.’

The camera gives a more uniformly defined field than most cameras of this type, but the definition is not sufficiently sharp to produce clear cut images. When a long exposure is made to reach faint stars there are three resulting forms of image. The fainter stars give a clear cut image, the next in brightness give an image with a dark centre surrounded by a halo, while the brighter stars give an image of uniform density but much enlarged. This variation in the images must be due to aberration, either spherical or chromatic, producing, instead of point images, discs of sensible size, possibly with a centre somewhat more intense than the surrounding portion. The difference in the appearance of the images of stars of different brightness on the negative is thus readily explained by the light of the fainter stars not being sufficient to form a halo, as in the next brighter stars, while in the very bright stars the light is strong enough to make the halo as dense as the central portion. The only question is whether this aberration is spherical or chromatic.

The most simple test for the presence of zonal errors in a lens is that of Hartmann, the theory involved being very simple, and the equipment for the experiment

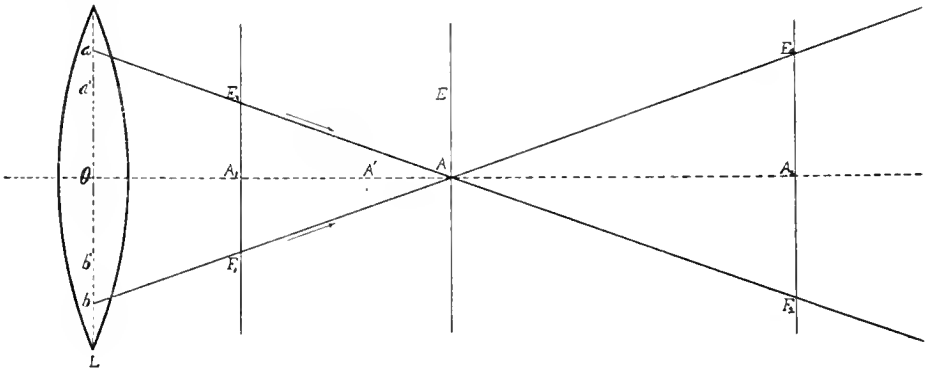


FIG. 38.

being within reach of any one. This method involves the determination of the point of intersection of rays of light passing through the lens at opposite ends of a diameter and equidistant from the centre.

Let  $L$  (Fig. 38) be the lens under test and consider two rays passing through  $a, b$ , so that  $oa = ob$ . These rays converge to a point  $A$  which is called the focus of these rays. If these rays are intercepted at  $A$  we find them in a single point, but if intercepted at  $E_1$  or  $E_2$  we find them separated by a distance  $d_1$  or  $d_2$ . These distances may be measured with a micrometer, or photographic plates may be placed at  $E_1, E_2$ , and the distances between the resulting images measured. This latter method has been employed in the present test.

Measuring the distances  $OA_1, OA_2$  and  $d_1, d_2$ , we can easily obtain the correct position of focus.

$$\begin{aligned} \text{Let } OA_1 &= A_1 & E_1 F_1 &= d_1 \\ OA_2 &= A_2 & E_2 F_2 &= d_2 \\ OA &= A \end{aligned}$$

Then  $A = A_1 + \frac{d_1}{d_1 + d_2} (A_2 - A_1)$ . This is a simple geometrical property requiring no proof.

Again, consider two rays passing through at  $a', b'$ . If the lens is correctly ground these two rays will converge to the point  $A$  as did  $a$  and  $b$ , and so with rays from all parts of the lens. But unfortunately this is a difficult condition to obtain, the best of lenses being but a close approximation to it. In place of converging to  $A, a'$  and  $b'$  converge to some other point, say  $A'$ , giving what is called zonal aberration, so that if we focus our camera for  $a$  and  $b$ , it is out of focus for  $a', b'$ , and we get a disc about our image.

Take two rays at a distance  $ou$  from the centre but on a diameter perpendicular to  $a, b$ , and consider their focus. If the lens is symmetrical for this zone, then the four rays will meet at the point  $A$ , their common focus, but if not symmetrical there will be two different foci for the two pairs of rays. This difference is called axial astigmatism and can be revealed in the Hartmann test for aberration.

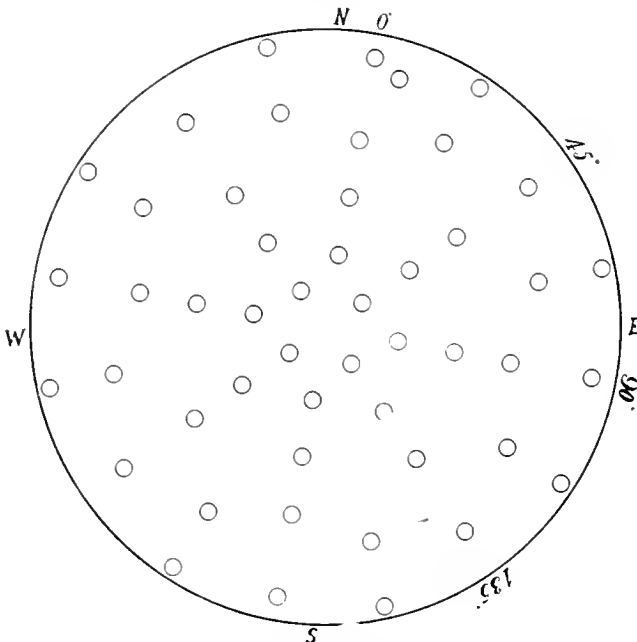


FIG. 39—Zonal Disc.



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The lens is covered with a zone plate of the form shown in Fig. 39. The apertures are placed in ten zones of 15, 25, 35, 45, 55, 65, 75, 85, 94 and 98 mm. radius respectively. Each pair of openings is duplicated by a second pair at right angles in order to determine the axial astigmatism. In the case of the zones of 15, 25, 35, 45, 55, 65, 85 and 94 mm. radius, symmetrical pairs of apertures are placed  $90^\circ$  apart, but in the zones of 75 and 98 mm. radius the apertures are only  $45^\circ$  apart, so the outer part of the lens is more thoroughly tested than the centre. This is necessary owing to the greater amount of light admitted by the outer zones.

By making an exposure at  $E_1$  and another at  $E_2$ , we can determine two positions of focus for each of the ten zones, these two positions being perpendicular to each other. An extra aperture in the zone plate enables one to identify the angle for the several zones and so avoid confusion in the determination of astigmatism.

The first zone plate used had apertures of 10 mm., but the diffraction at the edges was so great that in place of solid dark spots there were circular dark rings which did not permit of accurate measurement. The second zone plate used had a diameter of 203 mm. with apertures of 5.5 mm. These plates were made of medium weight bristol board. Exposures of 6 minutes were made on Capella. In order to avoid as much as possible chromatic aberration, Seed Process plates were used, their band of sensitiveness being narrow and confined chiefly to the blue and violet light beyond  $\lambda$  4600. A plate with a wider range of sensitiveness would give images so elongated radially by chromatic aberration as to render accurate measurements very difficult or impossible.

All measures were made on the Zeiss comparator, the graduations reading to thousandths of a millimetre and readily estimated to ten thousandths. Test plates were first made with 4 x 5 Seed plates, to determine the correct time of exposure, a plate-adaptor being used in the regular plate-holder. The positions corresponding to  $E_1$  and  $E_2$  were at 22 mm. and 67 mm., respectively, on the focussing scale on the camera tube. This gave the distance  $A_2 - A_1$  equal to 45 mm. In the appended results the focus given is that which would be used in setting according to the above mentioned scale. The actual focus of the camera was determined as follows:—The telescope was set midway between Castor and Pollux and a photograph taken, with the camera at its usual focus (47.5 mm. on the scale) and the zone plate removed. The distance between the images on the photographic plate was measured and found to be  $d = 79.5260$  mm.

From the Ephemeris we have—

| R. A.  | Dec.                     |
|--|--------------------------|
| Castor, $7^h 28^m 43^s.9$  | + $32^\circ 5' 28''.13$  |
| Pollux, $7^h 39^m 41^s.284$  | + $28^\circ 14' 56''.34$ |
| The difference in R. A. is $0^h 10^m 57^s.384 = 2^\circ 44' 20''.76$   |                          |
| Zenith distance of Castor is $57^\circ 54' 31''.87$  |                          |
| Zenith distance of Pollux is $61^\circ 45' 3''.6$  |                          |
| From $\cos a = \cos b \cos c + \sin b \sin c \cos A$ , we have $a = 4^\circ 30' 48''$<br>= the distance between Castor and Pollux. |                          |

Hence, from the cotangent of  $a$  and the value of  $d$  we have the focus required

$$f = 1060.3 \text{ millimetres.}$$

When the correct time of exposure had been obtained, the regular 8 x 10 plates were used and a series of exposures made at  $E_1$  and  $E_2$ . Although the original object in view was to test for spherical aberration at the centre, this was extended to cover the whole field of the lens and images were made extending across the plate from south to north, in order to determine the curvature of field. Nine images were obtained within the focus and nine without, their respective positions being:—

|             |               |                                |                                |   |   |
|-------------|---------------|--------------------------------|--------------------------------|---|---|
| Position A, | $5^{\circ}.3$ | from centre towards south end. |                                |   |   |
| "           | B,            | $4^{\circ}$                    | "                              | " | " |
| "           | C,            | $2^{\circ}.5$                  | "                              | " | " |
| "           | D,            | $1^{\circ}$                    | "                              | " | " |
| "           | E,            | at centre.                     |                                |   |   |
| "           | F,            | $1^{\circ}$                    | from centre towards north end. |   |   |
| "           | G,            | $2^{\circ}.5$                  | "                              | " | " |
| "           | H,            | $4^{\circ}$                    | "                              | " | " |
| "           | I,            | $5^{\circ}.5$                  | "                              | " | " |

Owing to the uncertainty of the weather, exposures at positions A, B, C, D and E were made on one plate without the focus, and then exposures were made on another plate at the same positions within the focus. Exposures at F, G, H and I were then made on two other plates. This unfortunately caused a slight change in the adjustment of the camera and the result was an unaccountable dip in the curvature of the field. Further test plates were made at positions E, F and H, which showed clearly that the dip was not due to any fault of the lens, the resulting curve being quite uniform, as shown in Figs. 43 and 44.

The several plates were first measured for aberration and astigmatism. A summary of the results is given in the appended tables and curves. As stated before, the positions  $E_1$  and  $E_2$  correspond to 22 mm. and 67 mm. on the scale attached to the camera. The camera was set at 47.5 mm. to determine the focus  $f = 1060.3$  mm. So we have  $A = 1034.8$  mm. and  $A_2 - A_1 = 45$  mm. To obtain the actual focus for each zone in the following results we must add 1034.8 mm. to each given focus.

|            |   |   |   |          |
|------------|---|---|---|----------|
| Position A | shows a negative aberration of 3.61 mm. |   |   |          |
| "          | B                                       | " | " | 3.82 mm. |
| "          | C                                       | " | " | 3.75 mm. |
| "          | D                                       | " | " | 3.63 mm. |
| "          | E                                       | " | " | 3.60 mm. |
| "          | F                                       | " | " | 3.63 mm. |
| "          | G                                       | " | " | 3.64 mm. |
| "          | H                                       | " | " | 3.82 mm. |
| "          | I                                       | " | " | 3.63 mm. |

Such a marked aberration, extending so uniformly across the field, shows beyond any doubt the cause of the diffuse appearance of the images already referred to. The curves in Figs. 40 and 41, each division representing 1 millimetre, show very clearly the magnitude of the aberration and its uniformity across the field from south to north. Another plate R, made on the east side of the field, shows a similar aberration, curve P, Fig. 42, representing it graphically.

Taking the mean focus for each zone we find the astigmatism so small as to be neglected at the centre of the field but increasing as we move outward. A closer examination reveals the fact that where  $\varphi = 0^{\circ}$ ,  $90^{\circ}$ ,  $67^{\circ}.5$  and  $157^{\circ}.5$ , the astigmatism is the greatest. This is due to the varying angle of incidence of the rays on the plate in the several positions A, B, C, etc. This variation in angle affects the distance between the images in the respective zones inversely as the angles they make with the north and south line. Thus (see Fig. 39) when  $\varphi = 0^{\circ}$ , the change in distance is greatest; when  $\varphi = 90^{\circ}$ , the change in distance is least; when  $\varphi = 45^{\circ}$ , the change is almost the same as when  $\varphi = 135^{\circ}$ . So we see that the apparent variation in astigmatism is due to the position of the plate and consequent distortion of some of the images rather than to any defect in the lens.

As already stated, the Seed Process plate used has its maximum sensitiveness about  $\lambda 4300$  in the blue light. Thinking perhaps the lens had originally been tested with yellow light, owing to the difficulty of obtaining monochromatic light in the blue, it was consequently decided to test the lens by visual or yellow light. Cramer Iso-

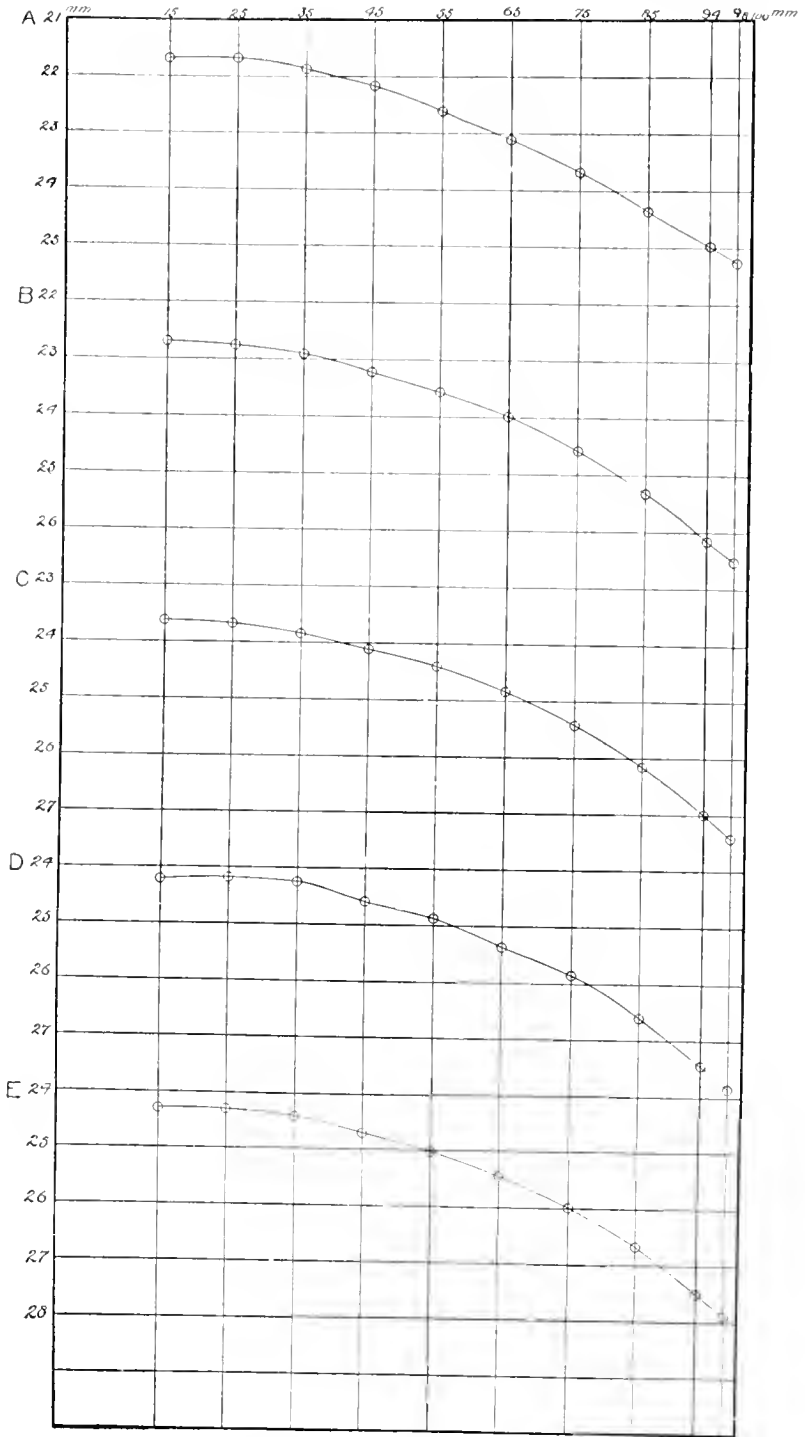


Fig. 40—Zonal Differences of Focus.



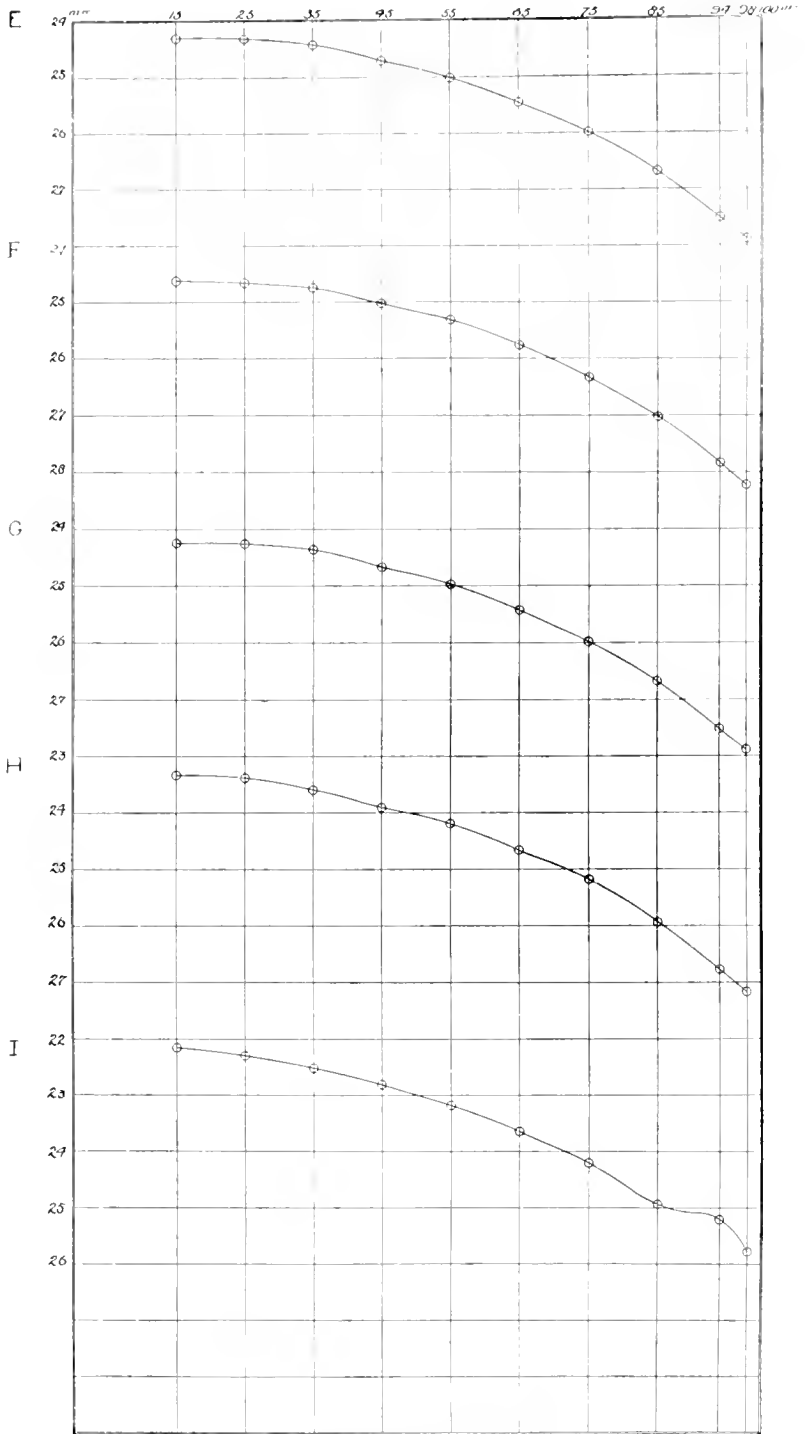


FIG. 41—Zonal Differences of Focus.



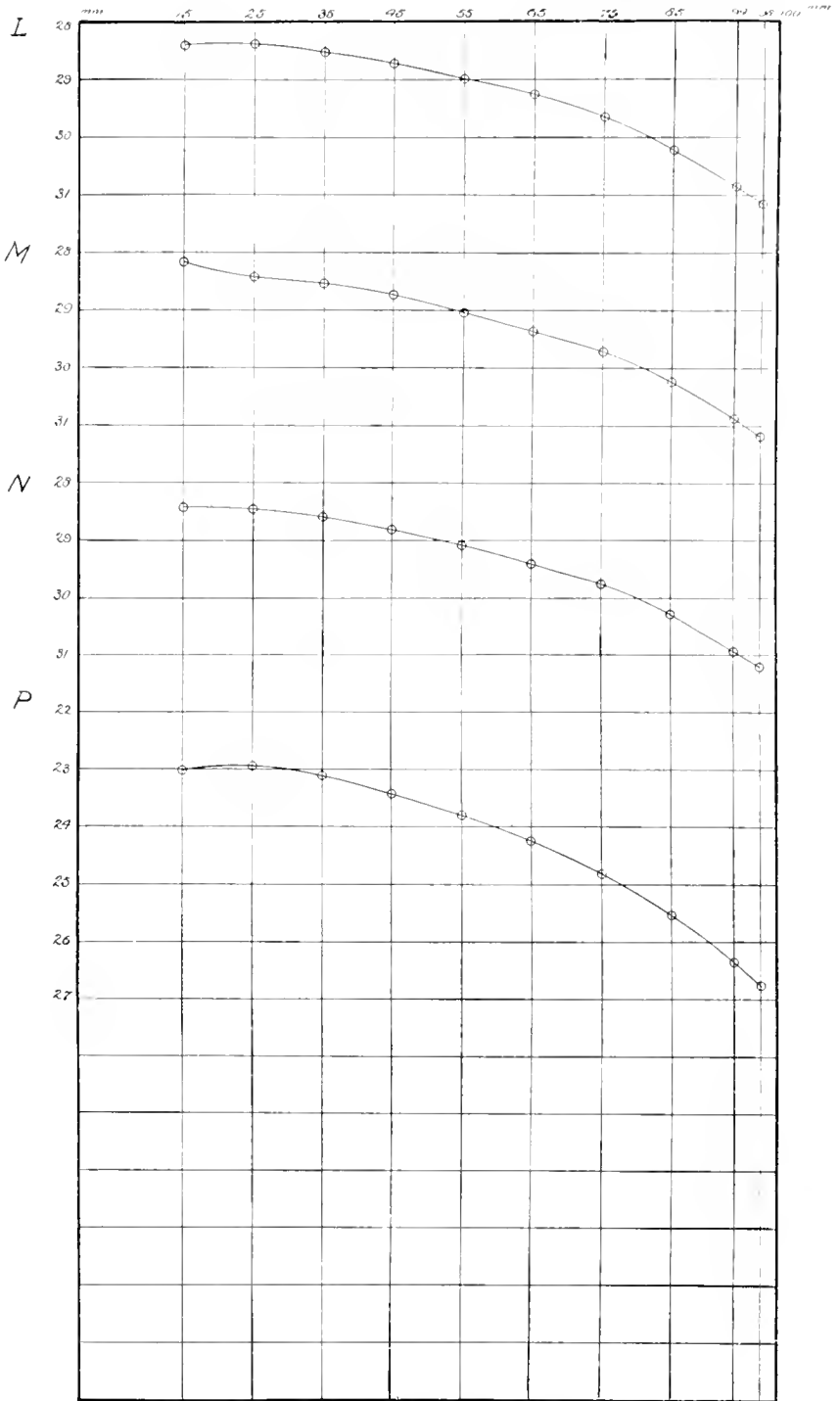


FIG. 42—Zonal Differences of Focus.





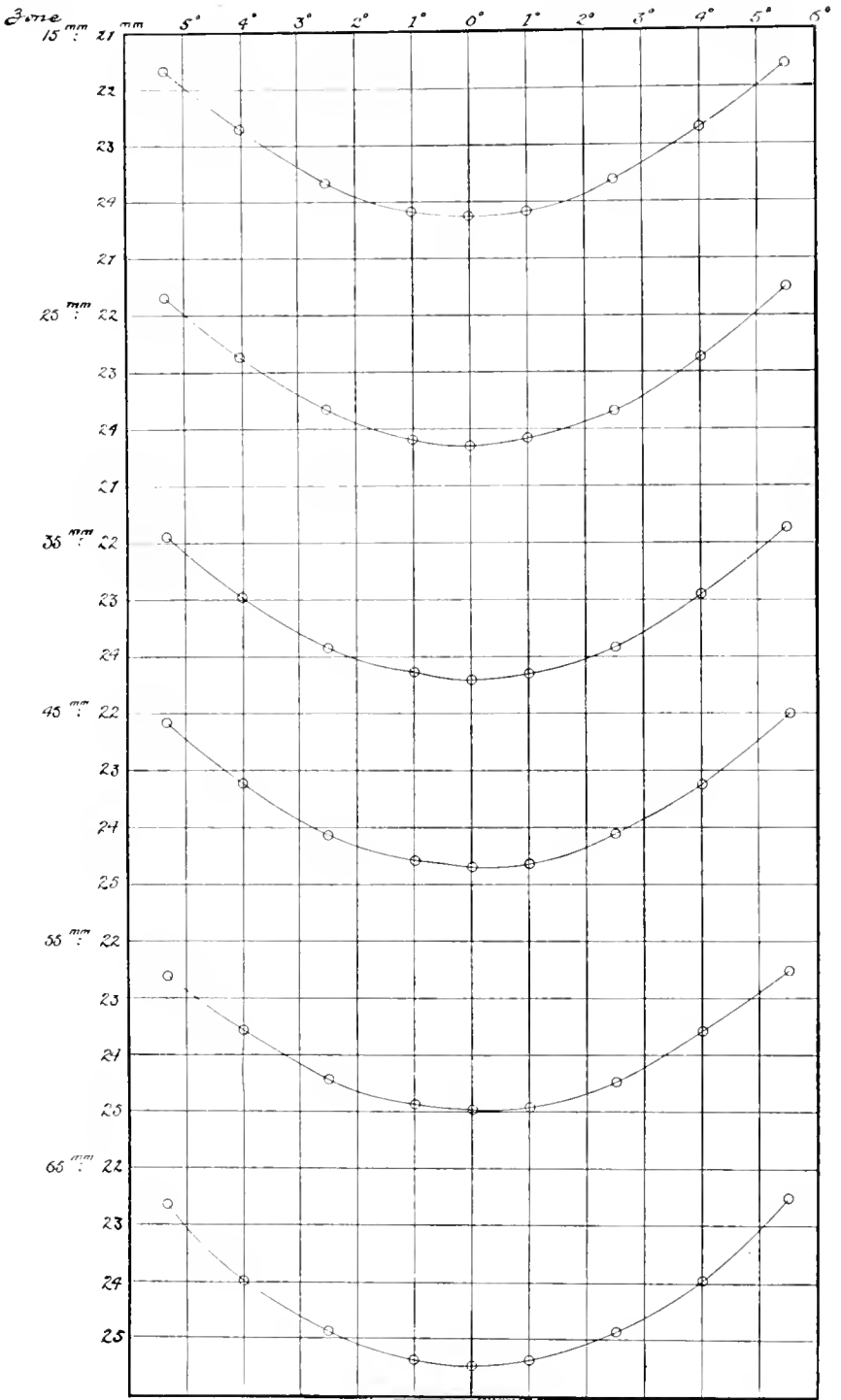


FIG. 43—Curvature of Field at different Zones.



*Zone*

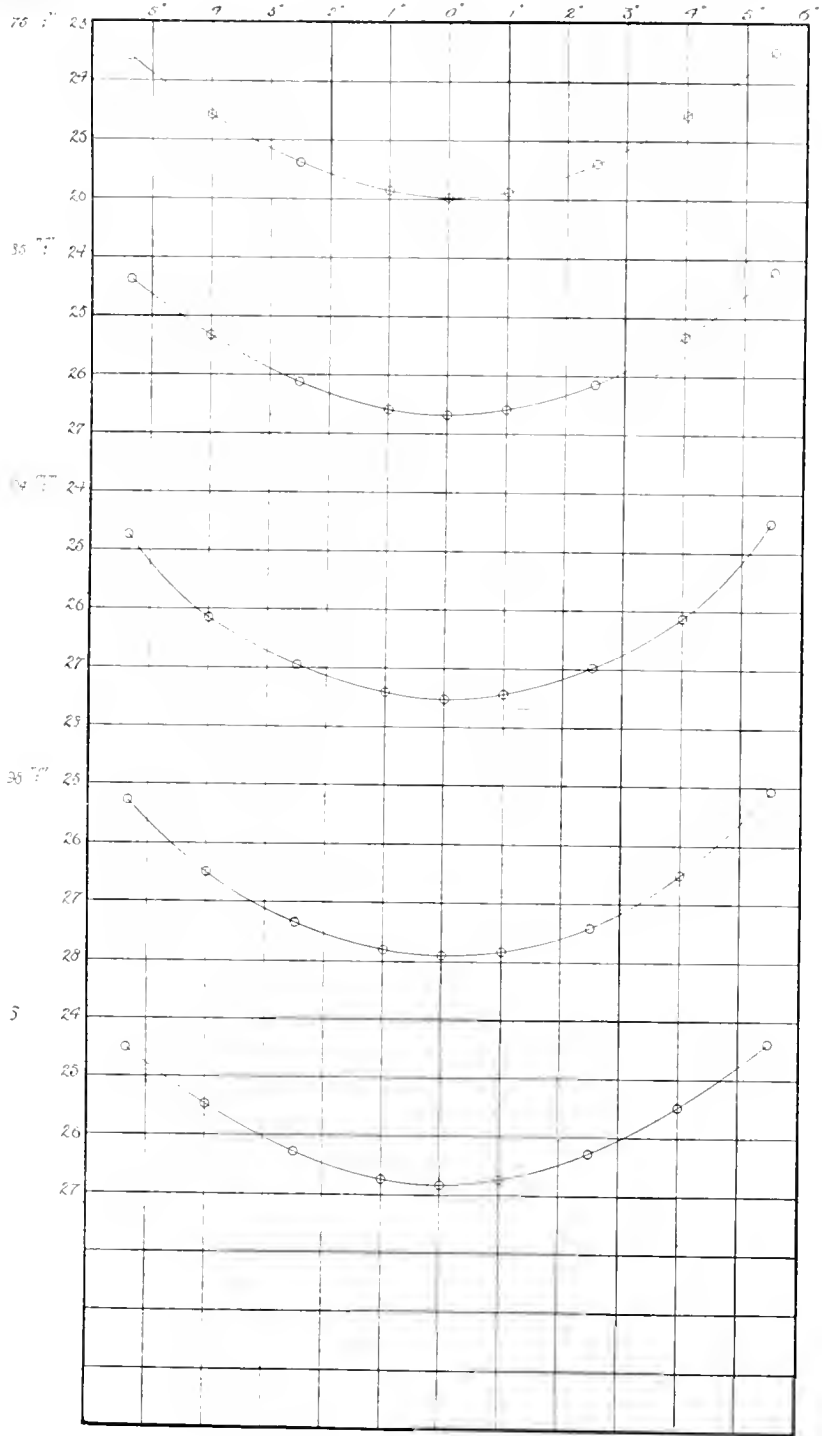


FIG. 44—Curvature of Field at different Zones.



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chromatic plates were substituted for the Seed Process plates and a yellow screen was placed just above the plate-holder to cut out the blue and violet light. The Cramer plate was used as it has a band of sensitiveness in the yellow-green light about  $\lambda$  5650, as well as the band of sensitiveness to blue and violet light possessed by all plates. Three exposures were made within the focus and three without, their positions being:

- Position L, 50' from centre to south.  
 " M, at centre.  
 " N, 50' from centre to north.

The exposure in each case was 5 minutes.

Comparing these with positions A to I, we find the aberration less by about 0.6 mm.

|            |                                |          |
|------------|--------------------------------|----------|
| Position L | showing negative aberration of | 2.77 mm. |
| " M        | " " "                          | 3.03 mm. |
| " N        | " " "                          | 2.78 mm. |

But it is not small enough to indicate any special adjustment of the lens surface to yellow light. The uniformity of the aberration is shown in *L, M, N*, Fig. 42. The astigmatism is similar to that shown by the Seed Process plate.

A uniform increase of about 3.5 mm. in the focus, as compared with the blue light, is due partly to refraction of the light in passing through the yellow screen. The screen being about 6 mm. thick, the refraction would lengthen the focus by about 2 mm., the refractive index of glass being about 1.57. The remaining 1.5 mm. is due to the difference in focus of blue and yellow light.

Combining the results of positions A to I (see table XIV.), we have the focus of each zone of the lens at nine different points extending from  $5^{\circ}.3$  on one side of the centre to  $5^{\circ}.5$  on the other side. Figs. 43 and 44 show the curvature as given from these foci, the coordinates being the diameter of the field in degrees and the zonal foci in millimetres. As in the case of the aberration these curves are very uniform, indicating a difference of about 2.5 mm. between the focus at the edge of the field and that at the centre.

Since the zonal foci of the lens vary so much from the centre to the edge no one position of focus is suitable to all the lenses. To obtain a uniform field and at the same time get as sharp a definition as possible, we must study the effect produced by the various zones when out of focus.

If we set, for example, the camera at the focus of the zone with radius of 65 mm., then other zones will be out of focus and there will be discs or circles of confusion about each image. The density and size of these circles depend on the extent to which the several zones are out of focus and also on the area of these zones. The diameter of these circles of confusion may be determined as follows:—

$$d = 2r \frac{(F - F_0)}{F_0}$$

where  $d$  = diameter of circle of confusion,

$r$  = radius of zone,

$F$  = focus of zone,

$F_0$  = focus at which the camera is set.

This determines for us the circles of confusion but it does not give us any idea of the effect on the image. A circle of confusion of 20" diameter and produced by a zone of 15 mm. radius would not be nearly so injurious to the image as one of the same diameter produced by a zone of 75 mm. radius. We see that simply determining the circles of confusion for the several zones will not give us the effect of the circles on the images, and so will not aid us in adjusting the camera to obtain the best images

possible under existing conditions. We must determine at what position of focus the lens is most efficient. The following formula by Hartmann gives a test for the efficiency of a lens at various foci:—

$$T = \frac{200000}{F_0^2} \cdot \frac{\sum r^2 (F - F_0)}{\sum r}$$

where  $T$  = efficiency of lens,  
 $F$  = focus of zone,  
 $F_0$  = focus at which the camera is set,  
 $r$  = radius of zone.

(100000 is introduced simply to transfer the decimal point and so avoid exceedingly small numbers.) According to this test an objective is moderately good when  $T$  is greater than 1.5, good when  $T$  is between 0.5 and 1.5, and exceedingly good when  $T$  is less than 0.5. But as this criterion of efficiency refers to telescope objectives where the field of view and angular aperture are small, it is not an accurate test for photographic objectives of wide aperture.

Using the above formula, the best positions of focus at the several positions, A, B, C, etc., were obtained. Table XV. gives these foci, the diameters of the circles of confusion, and the efficiency of the lens. Curve S, Fig. 44, shows the combined results for the several positions A to I. From this curve it may be concluded that the best uniform field would be obtained by setting the camera at 25.75 mm. or 26.0 mm.

*Testing for Chromatic Aberration.*

Although the foregoing tests revealed a much greater spherical aberration than is consistent with the production of good negatives, objection was taken to the statement that this aberration was the cause of the observed defects in the images. Accordingly it was decided to test for chromatic aberration also.

The camera was detached from the telescope and mounted on a table, the source of light being an arc-lamp about 400 yards distant. The spectrograph was placed with the slit at the focus of the camera which was in line with the collimation tube. A cardboard disc was placed over the camera objective, the light entering through two oblong openings, 3 mm. by 8.5 mm., symmetrically placed on a common diameter.

Exposures were made with the slit first inside the camera focus and then outside, isochromatic plates being used to obtain the  $D$  lines. Images of the slits in the disc were thus obtained as produced by light of various wave-lengths. By measuring the distances between these images at twelve points and applying the Hartmann formula the focus of the camera was obtained for twelve different wave-lengths, as shown in the following table:—

| Wave-length.                  | Focus.    |
|-------------------------------|-----------|
| $\lambda$ 5893, $D$ . . . . . | 41.93 mm. |
| 5500 . . . . .                | 41.24 "   |
| 5180 . . . . .                | 40.33 "   |
| 4880 $H\beta$ . . . . .       | 39.30 "   |
| 4737 . . . . .                | 39.07 "   |
| 4520 . . . . .                | 38.62 "   |
| 4370 . . . . .                | 38.73 "   |
| 4230 . . . . .                | 38.79 "   |
| 4115 . . . . .                | 39.00 "   |
| 4020 . . . . .                | 39.71 "   |
| 3933, $K$ . . . . .           | 39.98 "   |
| 3780 . . . . .                | 40.88 "   |

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Fig. 45 represents graphically the various foci and the chromatic aberration. The minimum focus is about  $H\gamma$  and, while there is a range of 3.12 mm. in focus in the region between  $\lambda$  5893 and  $\lambda$  3780, there is less than 1 mm. range in the photographic region.

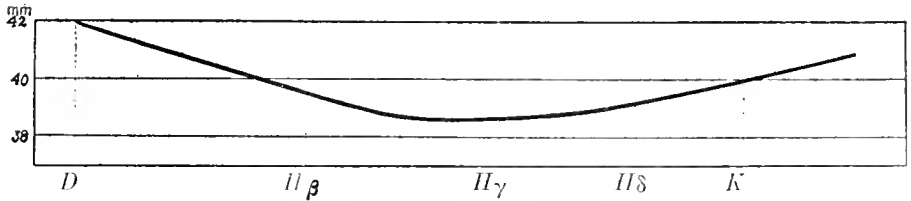


FIG. 45—Chromatic Aberration Curve.

Comparing this with the test for spherical aberration we have—

- (a) Minimum spherical aberration of - 3.6 mm.
- (b) Maximum chromatic aberration in photographic region of 1 mm.

Even if we allow for the chromatic aberration of 3 mm. at  $\lambda$  5893, the light here is not rich enough in actinic properties to produce the observed halo. It seemed, therefore, unnecessary to continue the investigation *re* chromatic aberration.

*Changing the Distance between the Components of the Outer Combination.*

Prof. Hastings, of Yale University, who had been kept informed of the results of these tests, suggested that there might be sufficient internal reflection between the components of the objective to produce the observed halo and that this might be eliminated by increasing or decreasing the separation. Although we still felt that the defect was due to spherical aberration, this suggestion coming from the designer of the lens claimed our most careful attention and a series of tests were accordingly made. The original separation (one thickness of a postage stamp) was removed and new separations of various thicknesses used. Little blocks built up from bristol board were used until the best adjustment was obtained, after which hard rubber blocks were used.

The following table shows the tests and results:—

| Date.            | Separation of Components. | Focus.*  | Spherical Aberration. | Description of Images.   |
|------------------|---------------------------|----------|-----------------------|--|
| 1908.            |                           |          |                       |  |
| Jan . . . . .    | 0.004 inches.             | 47.5 mm. | - 3.6 mm.             | Described in first part of appendix.   |
| 1909.            |                           |          |                       |  |
| Jan. 12. . . . . | 0.012 "                   | 47.0 "   | .....                 | No change.   |
| " 26. . . . .    | Tissue paper.             | 47.5 "   | .....                 | "  |
| Feb. 2. . . . .  | "                         | 47.5 "   | .....                 | $\frac{1}{2}$ " and $\frac{1}{4}$ " discs were placed on lens to cut off outer portion, but there was very little improvement. |
| " 25. . . . .    | 0.132 inches.             | 26.5 "   | + 2.4 mm.             | Images about the same as originally.   |
| Apr. 20. . . . . | 0.070 "                   | 36.5 "   | - 0.5 "               | Images much improved. Halo greatly reduced.  |
| May 23. . . . .  | 0.077 "                   | 36.0 "   | - 0.3 "               | Images much the same as with .070 separation.  |

\* Focus here refers to the scale on the camera tube.

Curve  $\alpha$ , Fig. 46, shows the aberration with a separation of 0.004 inches, curve  $\beta$  shows the aberration with a separation of 0.132 inches, and curve  $\gamma$  shows the aberration with a separation of 0.070 inches. Figure 47 shows cuts of the Pleiades taken with the different separations.

Examining the above table it is seen that increasing the separation, shortened the focus and changed the aberration. Coincident with the change in aberration there was a decided change in the star images. Aberrations of  $-3.6$  mm. and  $+2.4$  mm. were accompanied by a very marked halo, while with an aberration of  $-0.5$  mm. the halo was negligible. Changing the separation to 0.070 inches has undoubtedly improved the objective as the field remained practically unchanged, and the halo was so small as to be neglected. But that this improvement has been effected by the removal of internal reflection does not seem at all probable. On the contrary, the above results seem to me to be but additional proof that the observed halo has been caused by spherical aberration, as was stated at the beginning of this appendix. It is not at all likely that the aberration and the halo would disappear simultaneously if the halo were caused by internal reflection.

*Note.*—Since the conclusion of the above work a communication has been received from the makers of the objective, stating that they also believe the defect to be due to spherical aberration and expressing their willingness to remove it without additional charge.

TABLE I.  
ZONAL FOCI: POSITION A.

| Radius of Zone | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|----------------|--------|--------|--------|--------|-------|--------------|
|                | 0      | mm.    | mm.    |        |       |              |
| 15 mm.         | 45     | 0.6450 | 0.6826 | 21.86  |       | +0.20        |
|                | 135    | 0.6333 | 0.6938 | 21.47  | 21.66 | -0.19        |
| 25             | 0      | 1.0432 | 1.1627 | 21.28  |       | -0.37        |
|                | 90     | 1.0746 | 1.1201 | 22.03  | 21.65 | +0.38        |
| 35             | 45     | 1.5131 | 1.5651 | 22.12  |       | +0.23        |
|                | 135    | 1.4948 | 1.6115 | 21.66  | 21.89 | -0.23        |
| 45             | 0      | 1.9259 | 2.0621 | 21.73  |       | -0.44        |
|                | 90     | 1.9921 | 1.9715 | 22.62  | 22.17 | +0.45        |
| 55             | 45     | 2.4355 | 2.3590 | 22.86  |       | +0.26        |
|                | 135    | 2.4166 | 2.4523 | 22.34  | 22.60 | -0.26        |
| 65             | 0      | 2.8795 | 2.8646 | 22.56  |       | -0.05        |
|                | 90     | 2.9851 | 2.7288 | 22.66  | 22.61 | +0.05        |
| 75             | 22.5   | 3.4195 | 3.1358 | 23.17  |       | -0.15        |
|                | 67.5   | 3.5344 | 3.0497 | 24.16  |       | +0.54        |
|                | 112.5  | 3.4794 | 3.1066 | 23.77  |       | +0.15        |
|                | 157.5  | 3.3935 | 3.2266 | 23.07  | 23.62 | -0.55        |
| 85             | 45     | 4.0807 | 3.3663 | 24.66  |       | +0.29        |
|                | 135    | 4.0195 | 3.4899 | 24.09  | 24.37 | -0.28        |
| 94             | 0      | 4.5566 | 3.7376 | 21.72  |       |              |
|                | 90     |        |        |        | 24.72 |              |
| 98             | 22.5   | 4.8567 | 3.7280 | 25.46  |       | +0.20        |
|                | 67.5   |        |        |        |       |              |
|                | 112.5  |        |        |        |       |              |
|                | 157.5  | 4.8157 | 3.8320 | 25.06  | 25.26 | -0.20        |



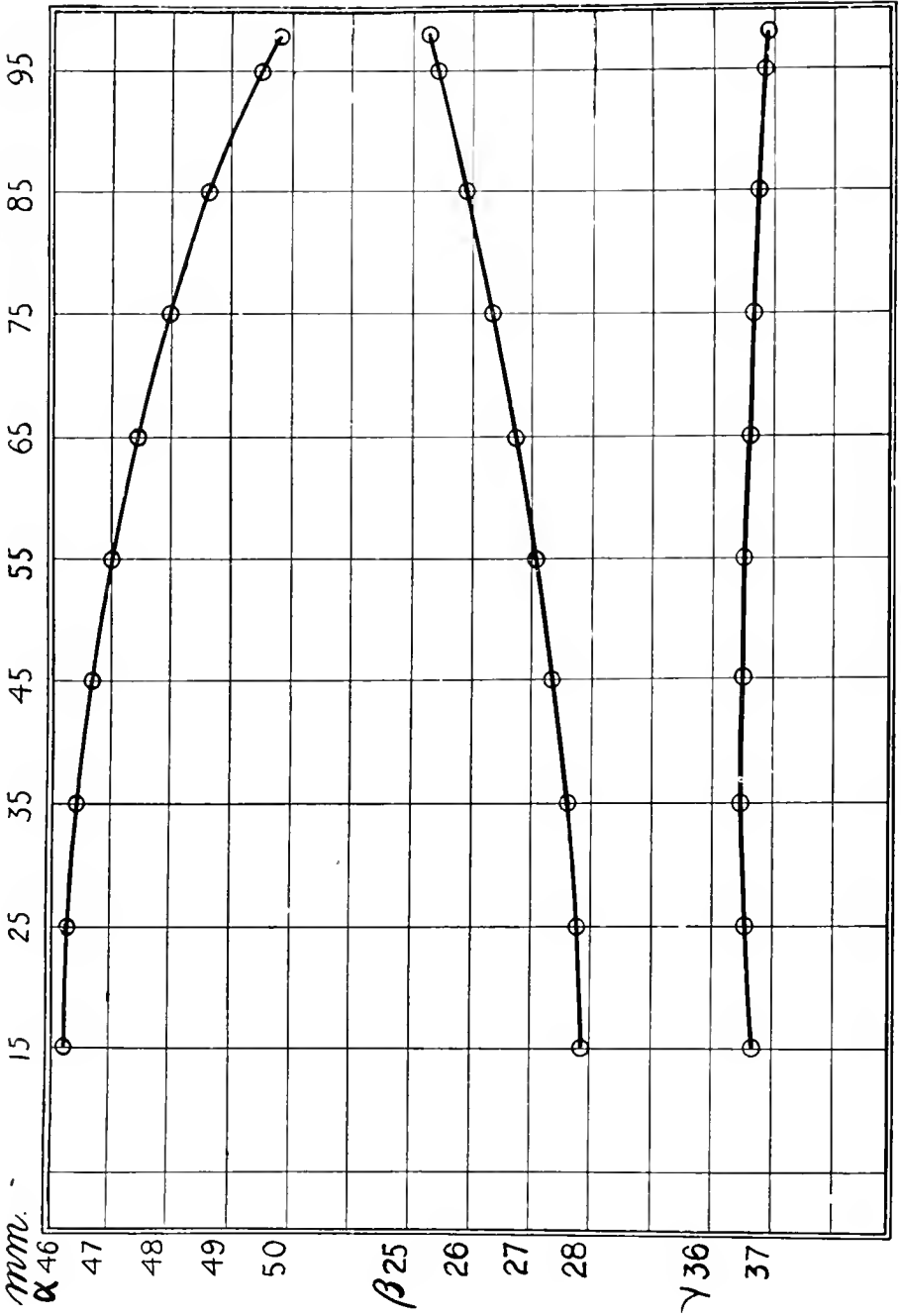


FIG. 46.—Zonal Differences of Focus.





Focus 47.0  
Separation—Tissue Paper.  
No Disc.



Focus 47.0  
Separation—Tissue Paper.  
 $\frac{1}{4}$ -in. Disc.



Focus 26.5  
Separation—0.132 inches.



Focus 36.5  
Separation—0.070 inches.

FIG. 47—Star Photographs at Different Separations.



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TABLE II.  
ZONAL FOCI: POSITION B.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0·6694 | 0·6536 | 22·77  |       | +0·08        |
|                 | 135    | 0·6625 | 0·6555 | 22·62  | 22·69 | -0·07        |
| 25.....         | 0      | 1·1061 | 1·1020 | 22·54  |       | -0·22        |
|                 | 90     | 1·1248 | 1·0793 | 22·99  | 22·76 | +0·23        |
| 35.....         | 45     | 1·5766 | 1·5057 | 23·02  |       | +0·10        |
|                 | 135    | 1·5740 | 1·5298 | 22·82  | 22·92 | -0·10        |
| 45.....         | 0      | 2·0353 | 1·9518 | 22·97  |       | -0·25        |
|                 | 90     | 2·0708 | 1·8979 | 23·48  | 23·22 | +0·26        |
| 55.....         | 45     | 2·5308 | 2·2741 | 23·70  |       | +0·14        |
|                 | 135    | 2·5368 | 2·3375 | 23·42  | 23·56 | -0·14        |
| 65.....         | 0      | 3·0385 | 2·7147 | 23·77  |       | -0·22        |
|                 | 90     | 3·0850 | 2·6503 | 24·21  | 23·99 | +0·22        |
| 75.....         | 22·5   | 3·5797 | 2·9946 | 24·50  |       | -0·07        |
|                 | 67·5   | 3·6489 | 2·9584 | 24·85  |       | +0·28        |
|                 | 112·5  | 3·6175 | 2·9892 | 24·64  |       | +0·07        |
|                 | 157·5  | 3·5760 | 3·0162 | 24·30  | 24·57 | -0·27        |
| 85.....         | 45     | 4·2251 | 3·2505 | 25·43  |       | +0·12        |
|                 | 135    | 4·2075 | 3·3061 | 25·20  | 25·31 | -0·11        |
| 94.....         | 0      | 4·7707 | 3·5186 | 25·90  |       | -0·28        |
|                 | 90     | 4·8840 | 3·4186 | 26·47  | 26·18 | +0·29        |
| 98.....         | 22·5   | 5·0322 | 3·5470 | 26·44  |       | -0·07        |
|                 | 67·5   | 5·0494 | 3·4591 | 26·71  |       | +0·20        |
|                 | 112·5  | 5·0914 | 3·5125 | 26·63  |       | +0·12        |
|                 | 157·5  | 5·0384 | 3·5950 | 26·26  | 26·51 | -0·25        |

TABLE III.  
ZONAL FOCI: POSITION C.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0·7003 | 0·6365 | 23·57  |       | -0·04        |
|                 | 135    | 0·7023 | 0·6334 | 23·66  | 23·61 | +0·05        |
| 25.....         | 0      | 1·1571 | 1·0546 | 23·54  |       | -0·10        |
|                 | 90     | 1·1701 | 1·0470 | 23·75  | 23·64 | +0·11        |
| 35.....         | 45     | 1·6446 | 1·4542 | 23·88  |       | +0·05        |
|                 | 135    | 1·6394 | 1·4625 | 23·78  | 23·83 | -0·05        |
| 45.....         | 0      | 2·1303 | 1·8615 | 24·02  |       | -0·10        |
|                 | 90     | 2·1444 | 1·8404 | 24·22  | 24·12 | +0·10        |
| 55.....         | 45     | 2·6238 | 2·2009 | 24·47  |       | +0·05        |
|                 | 135    | 2·6415 | 2·2368 | 24·37  | 24·42 | -0·05        |
| 65.....         | 0      | 3·1652 | 2·5791 | 24·80  |       | -0·05        |
|                 | 90     | 3·1857 | 2·5686 | 24·91  | 24·85 | +0·06        |
| 75.....         | 22·5   | 3·7187 | 2·8718 | 25·39  |       | -0·01        |
|                 | 67·5   | 3·7533 | 2·8700 | 25·50  |       | +0·10        |
|                 | 112·5  | 3·7401 | 2·8848 | 25·40  |       | 0·00         |
|                 | 157·5  | 3·7206 | 2·8957 | 25·30  | 25·40 | -0·10        |
| 85.....         | 45     | 4·3530 | 3·1223 | 26·20  |       | -0·07        |
|                 | 135    | 4·3522 | 3·1638 | 26·06  | 26·13 | -0·07        |
| 94.....         | 0      | 4·9560 | 3·3371 | 26·89  |       | -0·09        |
|                 | 90     | 5·0073 | 3·3159 | 27·07  | 26·98 | -0·09        |
| 98.....         | 22·5   | 5·2·15 | 3·3850 | 27·32  |       | -0·04        |
|                 | 67·5   | 5·2741 | 3·3635 | 27·48  |       | +0·12        |
|                 | 112·5  | 5·2528 | 3·3800 | 27·38  |       | -0·02        |
|                 | 157·5  | 5·2465 | 3·4089 | 27·26  | 27·36 | -0·10        |

TABLE IV.

ZONAL FOCI: POSITION D.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15mm.....       | 45     | 0 7204 | 0 6208 | 24 17  |       | -0 03        |
|                 | 135    | 0 7128 | 0 6106 | 24 24  | 24 20 | +0 04        |
| 25.....         | 0      | 1 1883 | 1 0255 | 24 15  |       | -0 02        |
|                 | 90     | 1 1963 | 1 0292 | 24 19  | 24 17 | +0 02        |
| 35.....         | 45     | 1 6786 | 1 4273 | 21 32  |       | +0 04        |
|                 | 135    | 1 6764 | 1 4340 | 24 25  | 24 28 | -0 03        |
| 45.....         | 0      | 2 1796 | 1 8131 | 24 57  |       | -0 02        |
|                 | 90     | 2 1843 | 1 8102 | 24 61  | 24 59 | +0 02        |
| 55.....         | 45     | 2 6726 | 2 1618 | 24 88  |       | -0 01        |
|                 | 135    | 2 7039 | 2 1805 | 24 91  | 24 89 | +0 02        |
| 65.....         | 0      | 3 2398 | 2 5165 | 25 33  |       | -0 02        |
|                 | 90     | 3 2503 | 2 5140 | 25 37  | 25 35 | +0 02        |
| 75.....         | 22 5   | 3 7991 | 2 8022 | 25 90  |       | +0 03        |
|                 | 67 5   | 3 8159 | 2 8151 | 25 90  |       | +0 03        |
|                 | 112 5  | 3 8110 | 2 8295 | 25 83  |       | -0 04        |
|                 | 157 5  | 3 8081 | 2 8193 | 25 86  | 25 87 | -0 01        |
| 85.....         | 45     | 4 4340 | 3 0715 | 26 58  |       | +0 01        |
|                 | 135    | 4 4154 | 3 0862 | 26 56  | 26 57 | -0 01        |
| 94.....         | 0      | 5 0594 | 3 2538 | 27 39  |       | -0 03        |
|                 | 90     | 5 0882 | 3 2528 | 27 45  | 27 42 | +0 03        |
| 98.....         | 22 5   | 5 3326 | 3 2971 | 27 81  |       | +0 01        |
|                 | 67 5   | 5 3485 | 3 3117 | 27 78  |       | -0 02        |
|                 | 112 5  | 5 3394 | 3 3005 | 27 81  |       | +0 01        |
|                 | 157 5  | 5 3453 | 3 3101 | 27 79  | 27 80 | -0 01        |

TABLE V.

ZONAL FOCI: POSITION E.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15mm.....       | 45     | 0 7243 | 0 6159 | 24 32  |       | +0 03        |
|                 | 135    | 0 7189 | 0 6145 | 24 26  | 24 29 | -0 03        |
| 25.....         | 0      | 1 1937 | 1 0189 | 24 28  |       | -0 02        |
|                 | 90     | 1 2020 | 1 0215 | 24 33  | 24 30 | +0 03        |
| 35.....         | 45     | 1 6884 | 1 4238 | 24 41  |       | +0 01        |
|                 | 135    | 1 6967 | 1 4277 | 24 40  | 24 40 | 0 00         |
| 45.....         | 0      | 2 1965 | 1 8049 | 24 70  |       | 0 00         |
|                 | 90     | 2 1948 | 1 8038 | 24 70  | 24 70 | 0 00         |
| 55.....         | 45     | 2 6918 | 2 1478 | 25 03  |       | +0 02        |
|                 | 135    | 2 7292 | 2 1765 | 25 00  | 25 01 | -0 01        |
| 65.....         | 0      | 3 2594 | 2 5023 | 25 46  |       | 0 00         |
|                 | 90     | 3 2631 | 2 5050 | 25 46  | 25 46 | 0 00         |
| 75.....         | 22 5   | 3 8166 | 2 7969 | 25 97  |       | -0 01        |
|                 | 67 5   | 3 8365 | 2 8062 | 25 99  |       | +0 01        |
|                 | 112 5  | 3 8381 | 2 8112 | 25 97  |       | -0 01        |
|                 | 157 5  | 3 8347 | 2 8057 | 25 99  | 25 98 | +0 01        |
| 85.....         | 45     | 4 4596 | 3 0610 | 26 68  |       | 0 00         |
|                 | 135    | 4 4751 | 3 0733 | 26 68  | 26 68 | 0 00         |
| 94.....         | 0      | 5 0876 | 3 2357 | 27 51  |       | 0 00         |
|                 | 90     | 5 1113 | 3 2509 | 27 51  | 27 51 | 0 00         |
| 98.....         | 22 5   | 5 3623 | 3 2966 | 27 87  |       | -0 02        |
|                 | 67 5   | 5 3789 | 3 2991 | 27 89  |       | 0 00         |
|                 | 112 5  | 5 3738 | 3 3000 | 27 88  |       | -0 01        |
|                 | 157 5  | 5 3729 | 3 2913 | 27 91  | 27 89 | +0 02        |

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TABLE VI.  
ZONAL FOCI: POSITION F.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0.7396 | 0.6978 | 24.70  |       | +0.11        |
|                 | 135    | 0.7315 | 0.6130 | 24.48  | 24.59 | -0.11        |
| 25.....         | 0      | 1.2242 | 1.0149 | 24.60  |       | -0.04        |
|                 | 90     | 1.2304 | 1.0127 | 24.68  | 24.64 | +0.04        |
| 35.....         | 45     | 1.7274 | 1.4155 | 24.73  |       | +0.01        |
|                 | 135    | 1.7267 | 1.4160 | 24.72  | 24.72 | +0.00        |
| 45.....         | 0      | 2.2431 | 1.7927 | 25.01  |       | -0.03        |
|                 | 90     | 2.2483 | 1.7875 | 25.07  | 25.04 | +0.03        |
| 55.....         | 45     | 2.7597 | 2.1330 | 25.35  |       | +0.01        |
|                 | 135    | 2.7761 | 2.1567 | 25.33  | 25.34 | -0.01        |
| 65.....         | 0      | 3.3281 | 2.4797 | 25.79  |       | -0.01        |
|                 | 90     | 3.3424 | 2.4826 | 25.82  | 25.80 | +0.02        |
| 75.....         | 22.5   | 3.9033 | 2.7731 | 26.31  |       | -0.02        |
|                 | 67.5   | 3.9215 | 2.7751 | 26.35  |       | +0.02        |
|                 | 112.5  | 3.9230 | 2.7794 | 26.34  |       | +0.01        |
|                 | 157.5  | 3.9134 | 2.7826 | 26.30  | 26.33 | -0.03        |
| 85.....         | 45     | 4.5513 | 3.0286 | 27.02  |       | +0.00        |
|                 | 135    | 4.5709 | 3.0376 | 27.03  | 27.02 | +0.01        |
| 94.....         | 0      | 5.1894 | 3.2095 | 27.80  |       | -0.04        |
|                 | 90     | 5.2240 | 3.2063 | 27.88  | 27.84 | +0.04        |
| 98.....         | 22.5   | 5.4615 | 3.2621 | 28.17  |       | -0.05        |
|                 | 67.5   | 5.4831 | 3.2539 | 28.24  |       | +0.02        |
|                 | 112.5  | 5.4846 | 3.2448 | 28.27  |       | +0.05        |
|                 | 157.5  | 5.4797 | 3.2630 | 28.21  | 28.22 | -0.01        |

TABLE VII.  
ZONAL FOCI: POSITION G.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0.7307 | 0.6203 | 21.29  |       | +0.04        |
|                 | 135    | 0.7256 | 0.6228 | 21.22  | 24.25 | -0.03        |
| 25.....         | 0      | 1.1958 | 1.0336 | 24.14  |       | -0.10        |
|                 | 90     | 1.2129 | 1.0297 | 24.34  | 24.24 | +0.10        |
| 35.....         | 45     | 1.7039 | 1.4425 | 24.37  |       | +0.01        |
|                 | 135    | 1.6995 | 1.4409 | 24.35  | 24.36 | -0.01        |
| 45.....         | 0      | 2.2025 | 1.8339 | 24.55  |       | -0.10        |
|                 | 90     | 2.2164 | 1.8137 | 24.75  | 24.65 | +0.10        |
| 55.....         | 45     | 2.7191 | 2.1758 | 25.00  |       | +0.03        |
|                 | 135    | 2.7339 | 2.1962 | 24.95  | 24.97 | -0.02        |
| 65.....         | 0      | 3.2652 | 2.5402 | 25.31  |       | -0.12        |
|                 | 90     | 3.2975 | 2.5100 | 25.55  | 25.43 | +0.12        |
| 75.....         | 22.5   | 3.8418 | 2.8348 | 25.89  |       | -0.07        |
|                 | 67.5   | 3.8710 | 2.8123 | 26.06  |       | +0.10        |
|                 | 112.5  | 3.8743 | 2.8281 | 26.01  |       | +0.05        |
|                 | 157.5  | 3.8565 | 2.8481 | 25.88  | 25.96 | -0.08        |
| 85.....         | 45     | 4.5039 | 3.0808 | 26.72  |       | +0.04        |
|                 | 135    | 4.5072 | 3.1024 | 26.65  | 26.68 | -0.03        |
| 94.....         | 0      | 5.1090 | 3.2893 | 27.38  |       | -0.13        |
|                 | 90     | 5.1685 | 3.2472 | 27.64  | 27.51 | +0.13        |
| 98.....         | 22.5   | 5.3913 | 3.3340 | 27.80  |       | -0.08        |
|                 | 67.5   | 5.4340 | 3.3009 | 28.00  |       | +0.12        |
|                 | 112.5  | 5.4298 | 3.3093 | 27.96  |       | +0.08        |
|                 | 157.5  | 5.3990 | 3.3450 | 27.78  | 27.88 | -0.10        |

TABLE VIII.  
ZONAL FOCI: POSITION H.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm           | 45     | 0 7933 | 0 6505 | 23 38  |       | +0 04        |
|                 | 135    | 0 7010 | 0 6528 | 23 30  | 23 34 | -0 04        |
| 25              | 0      | 1 1515 | 1 0961 | 23 05  |       | -0 31        |
|                 | 90     | 1 1775 | 1 0610 | 23 67  | 23 36 | +0 31        |
| 35              | 45     | 1 6507 | 1 4920 | 23 64  |       | +0 07        |
|                 | 135    | 1 6408 | 1 5005 | 23 50  | 23 57 | -0 07        |
| 45              | 0      | 2 1198 | 1 9152 | 23 64  |       | -0 27        |
|                 | 90     | 2 1580 | 1 8560 | 24 19  | 23 91 | +0 28        |
| 55              | 45     | 2 6321 | 2 2501 | 24 26  |       | +0 06        |
|                 | 135    | 2 6458 | 2 2870 | 24 14  | 24 20 | -0 06        |
| 65              | 0      | 3 1527 | 2 6581 | 24 41  |       | -0 26        |
|                 | 90     | 3 2126 | 2 5830 | 24 94  | 24 67 | +0 27        |
| 75              | 22 5   | 3 7121 | 2 9610 | 25 03  |       | -0 16        |
|                 | 67 5   | 3 7705 | 2 9036 | 25 42  |       | +0 23        |
|                 | 112 5  | 3 7646 | 2 9178 | 25 35  |       | +0 16        |
|                 | 157 5  | 3 7126 | 2 9823 | 24 95  | 25 19 | -0 24        |
| 85              | 45     | 4 3805 | 3 1994 | 26 01  |       | +0 06        |
|                 | 135    | 4 3703 | 3 2255 | 25 89  | 25 95 | -0 06        |
| 94              | 0      | 4 9372 | 3 4590 | 26 46  |       | -0 33        |
|                 | 90     | 5 0597 | 3 3340 | 27 13  | 26 79 | +0 34        |
| 98              | 22 5   | 5 2258 | 3 4928 | 26 97  |       | -0 19        |
|                 | 67 5   | 5 3153 | 3 4031 | 27 43  |       | +0 27        |
|                 | 112 5  | 5 3021 | 3 4164 | 27 37  |       | +0 21        |
|                 | 157 5  | 5 2219 | 3 5158 | 26 89  | 27 16 | -0 27        |

TABLE IX.  
ZONAL FOCI: POSITION I.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm           | 45     | 0 6675 | 0 6798 | 22 29  |       | +0 14        |
|                 | 135    | 0 6580 | 0 6869 | 22 02  | 22 15 | -0 13        |
| 25              | 0      | 1 0786 | 1 1508 | 21 77  |       | -0 53        |
|                 | 90     | 1 1344 | 1 1005 | 22 84  | 22 30 | +0 51        |
| 35              | 45     | 1 5761 | 1 5551 | 22 65  |       | +0 17        |
|                 | 135    | 1 5518 | 1 5765 | 22 32  | 22 48 | -0 16        |
| 45              | 0      | 1 9937 | 2 0341 | 22 27  |       | -0 55        |
|                 | 90     | 2 0805 | 1 9245 | 23 38  | 22 82 | +0 56        |
| 55              | 45     | 2 5249 | 2 3421 | 23 34  |       | +0 16        |
|                 | 135    | 2 5131 | 2 3998 | 23 02  | 23 18 | -0 16        |
| 65              | 0      | 2 9778 | 2 8323 | 23 06  |       | -0 59        |
|                 | 90     | 3 1123 | 2 6623 | 24 25  | 23 65 | +0 60        |
| 75              | 22 5   | 3 5401 | 3 1225 | 23 91  |       | -0 30        |
|                 | 67 5   | 3 6580 | 2 9877 | 24 77  |       | +0 56        |
|                 | 112 5  | 3 6314 | 3 0360 | 24 51  |       | +0 30        |
|                 | 157 5  | 3 5107 | 3 1646 | 23 67  | 24 21 | -0 54        |
| 85              | 45     | 4 2245 | 3 3275 | 25 17  |       | +0 20        |
|                 | 135    | 4 1720 | 3 4060 | 24 77  | 24 97 | -0 20        |
| 94              | 0      | 4 7029 | 3 6958 | 25 20  |       |              |
|                 | 90     |        |        |        | 25 20 |              |
| 98              | 22 5   | 5 0145 | 3 6885 | 25 93  |       | +0 15        |
|                 | 67 5   |        |        |        |       |              |
|                 | 112 5  |        |        |        |       |              |
|                 | 157 5  | 4 9712 | 3 7578 | 25 63  | 25 78 | -0 15        |



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TABLE X.  
ZONAL FOCI: POSITION L.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0·8580 | 0·5011 | 28·41  | ..... | +0·03        |
|                 | 135    | 0·8478 | 0·4980 | 28·35  | 28·38 | -0·03        |
| 25.....         | 0      | 1·4122 | 0·8305 | 28·34  | ..... | -0·02        |
|                 | 90     | 1·4257 | 0·8315 | 28·38  | 28·36 | +0·02        |
| 35.....         | 45     | 2·0004 | 1·1616 | 28·47  | ..... | -0·04        |
|                 | 135    | 2·0018 | 1·1533 | 28·55  | 28·51 | +0·04        |
| 45.....         | 0      | 2·5920 | 1·4647 | 28·75  | ..... | +0·03        |
|                 | 90     | 2·5883 | 1·4712 | 28·69  | 28·72 | -0·03        |
| 55.....         | 45     | 3·1567 | 1·7504 | 28·95  | ..... | -0·05        |
|                 | 135    | 3·1968 | 1·7537 | 29·06  | 29·00 | +0·06        |
| 65.....         | 0      | 3·8030 | 2·0479 | 29·25  | ..... | -0·01        |
|                 | 90     | 3·8094 | 2·0455 | 29·28  | 29·26 | +0·02        |
| 75.....         | 22·5   | 4·4142 | 2·2906 | 29·59  | ..... | -0·08        |
|                 | 67·5   | 4·4469 | 2·2925 | 29·69  | ..... | +0·02        |
|                 | 112·5  | 4·4305 | 2·2881 | 25·68  | ..... | +0·01        |
|                 | 157·5  | 4·4525 | 2·2920 | 29·71  | 29·67 | +0·04        |
| 85.....         | 45     | 5·1293 | 2·5171 | 30·19  | ..... | -0·05        |
|                 | 135    | 5·1351 | 2·4940 | 30·29  | 30·24 | +0·05        |
| 94.....         | 0      | 5·7911 | 2·6695 | 30·81  | ..... | -0·04        |
|                 | 90     | 5·8120 | 2·6555 | 30·89  | 30·85 | +0·04        |
| 98.....         | 22·5   | 6·0783 | 2·7200 | 31·09  | ..... | -0·06        |
|                 | 67·5   | 6·0767 | 2·6950 | 31·17  | ..... | +0·02        |
|                 | 112·5  | 6·0729 | 2·6946 | 31·17  | ..... | +0·02        |
|                 | 157·5  | 6·0908 | 2·7050 | 31·16  | 31·15 | +0·01        |

TABLE XI.  
ZONAL FOCI: POSITION M.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 | °      | mm.    | mm.    |        |       |              |
| 15 mm.....      | 45     | 0·8617 | 0·5145 | 28·18  | ..... | +0·02        |
|                 | 135    | 0·8519 | 0·5111 | 28·13  | 28·16 | -0·03        |
| 25.....         | 0      | 1·4154 | 0·8238 | 28·44  | ..... | -0·02        |
|                 | 90     | 1·4309 | 0·8295 | 28·49  | 28·46 | +0·03        |
| 35.....         | 45     | 2·0053 | 1·1647 | 28·47  | ..... | -0·06        |
|                 | 135    | 2·0039 | 1·1490 | 28·60  | 28·53 | +0·07        |
| 45.....         | 0      | 2·5951 | 1·4685 | 28·74  | ..... | -0·01        |
|                 | 90     | 2·5865 | 1·4601 | 28·76  | 28·75 | +0·01        |
| 55.....         | 45     | 3·1740 | 1·7598 | 28·95  | ..... | -0·08        |
|                 | 135    | 3·2043 | 1·7498 | 29·11  | 29·03 | +0·08        |
| 65.....         | 0      | 3·8230 | 2·0360 | 29·36  | ..... | 0·00         |
|                 | 90     | 3·8263 | 2·0381 | 29·36  | 29·36 | 0·00         |
| 75.....         | 22·5   | 4·4467 | 2·2842 | 29·73  | ..... | +0·03        |
|                 | 67·5   | 4·4591 | 2·2817 | 29·59  | ..... | -0·11        |
|                 | 112·5  | 4·4541 | 2·2803 | 29·76  | ..... | +0·06        |
|                 | 157·5  | 4·4353 | 2·2760 | 29·74  | 29·70 | +0·04        |
| 85.....         | 45     | 5·1375 | 2·4931 | 30·30  | ..... | +0·05        |
|                 | 135    | 5·1476 | 2·5197 | 30·21  | 30·25 | -0·04        |
| 94.....         | 0      | 5·8073 | 2·6596 | 30·86  | ..... | -0·01        |
|                 | 90     | 5·8189 | 2·6630 | 30·87  | 30·87 | 0·00         |
| 98.....         | 22·5   | 6·0981 | 2·6932 | 31·21  | ..... | +0·02        |
|                 | 67·5   | 6·1118 | 2·7059 | 31·19  | ..... | 0·00         |
|                 | 112·5  | 6·0862 | 2·7090 | 31·14  | ..... | -0·05        |
|                 | 157·5  | 6·0983 | 2·6950 | 31·21  | 31·19 | +0·02        |

TABLE XII.  
ZONAL FOCI: POSITION N.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 |        | mm.    | mm.    |        |       |              |
| 15mm            | 45     | 0 8573 | 0 4968 | 28 49  |       | + 0 07       |
|                 | 135    | 0 8578 | 0 5042 | 28 34  | 28 42 | - 0 08       |
| 25              | 0      | 1 4272 | 0 8332 | 28 41  |       | - 0 05       |
|                 | 90     | 1 4232 | 0 8235 | 28 51  | 28 46 | + 0 05       |
| 35              | 45     | 2 0043 | 1 1518 | 28 58  |       | - 0 02       |
|                 | 135    | 2 0138 | 1 1526 | 28 61  | 28 60 | + 0 01       |
| 45              | 0      | 2 6017 | 1 4565 | 28 85  |       | + 0 04       |
|                 | 90     | 2 5934 | 1 4642 | 28 76  | 28 81 | - 0 05       |
| 55              | 45     | 3 1837 | 1 7478 | 29 05  |       | 0 00         |
|                 | 135    | 3 2112 | 1 7647 | 29 04  | 29 05 | - 0 01       |
| 65              | 0      | 3 8245 | 2 0250 | 29 42  |       | + 0 01       |
|                 | 90     | 3 8307 | 2 0334 | 29 40  | 29 41 | - 0 01       |
| 75              | 22 5   | 4 4507 | 2 2902 | 29 71  |       | - 0 04       |
|                 | 67 5   | 4 4655 | 2 2819 | 29 78  |       | + 0 03       |
|                 | 112 5  | 4 4729 | 2 2797 | 29 81  |       | + 0 06       |
|                 | 157 5  | 4 4521 | 2 2895 | 29 72  | 29 75 | - 0 03       |
| 85              | 45     | 5 1540 | 2 5082 | 30 27  |       | - 0 62       |
|                 | 135    | 5 1560 | 2 4981 | 30 31  | 30 29 | + 0 02       |
| 94              | 0      | 5 8248 | 2 6439 | 30 95  |       | + 0 03       |
|                 | 90     | 5 8086 | 2 6549 | 30 88  | 30 92 | - 0 04       |
| 98              | 22 5   | 6 0993 | 2 6965 | 31 20  |       | 0 00         |
|                 | 67 5   | 6 1101 | 2 7062 | 31 19  |       | - 0 01       |
|                 | 112 5  | 6 1006 | 2 6947 | 31 21  |       | + 0 01       |
|                 | 157 5  | 6 0933 | 2 6951 | 31 20  | 31 20 | 0 00         |

TABLE XIII.  
ZONAL FOCI: POSITION R.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. | Astigmatism. |
|-----------------|--------|--------|--------|--------|-------|--------------|
|                 |        | mm.    | mm.    |        |       |              |
| 15mm            | 45     | 0 6950 | 0 6533 | 23 20  |       | + 0 18       |
|                 | 135    | 0 6707 | 0 6506 | 22 84  | 23 02 | - 0 18       |
| 25              | 0      | 1 1187 | 1 1600 | 22 69  |       | - 0 23       |
|                 | 90     | 1 1413 | 1 0780 | 23 14  | 22 92 | + 0 23       |
| 35              | 45     | 1 6051 | 1 5079 | 23 20  |       | + 0 08       |
|                 | 135    | 1 5904 | 1 5168 | 23 03  | 23 12 | - 0 09       |
| 45              | 0      | 2 0648 | 1 9508 | 23 14  |       | - 0 30       |
|                 | 90     | 2 0968 | 1 8769 | 23 74  | 23 44 | + 0 30       |
| 55              | 45     | 2 5811 | 2 2793 | 23 90  |       | + 0 12       |
|                 | 135    | 2 5683 | 2 3143 | 23 67  | 23 78 | - 0 11       |
| 65              | 0      | 3 0716 | 2 7009 | 23 94  |       | - 0 28       |
|                 | 90     | 3 1285 | 2 6173 | 24 50  | 24 22 | + 0 28       |
| 75              | 22 5   | 3 6463 | 2 9964 | 24 70  |       | - 0 09       |
|                 | 67 5   | 3 6927 | 2 9238 | 25 11  |       | + 0 32       |
|                 | 112 5  | 3 6642 | 2 9616 | 24 89  |       | + 0 10       |
|                 | 157 5  | 3 6180 | 3 0345 | 24 47  | 24 79 | - 0 32       |
| 85              | 45     | 4 2992 | 3 2352 | 25 68  |       | + 0 15       |
|                 | 135    | 4 2542 | 3 2864 | 25 39  | 25 53 | - 0 14       |
| 94              | 0      | 4 8501 | 3 5156 | 26 09  |       | - 0 30       |
|                 | 90     | 4 9240 | 3 3800 | 26 68  | 26 39 | + 0 29       |
| 98              | 22 5   | 5 1406 | 3 5317 | 26 67  |       | - 0 12       |
|                 | 67 5   | 5 2145 | 3 4394 | 27 12  |       | + 0 33       |
|                 | 112 5  | 5 1649 | 3 4780 | 26 89  |       | + 0 10       |
|                 | 157 5  | 5 1125 | 3 5791 | 26 47  | 26 79 | - 0 32       |

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TABLE XIV.

ZONAL FOCI.

| Radius of Zone. | Position. |       |       |       |       |       |
|-----------------|-----------|-------|-------|-------|-------|-------|
|                 | A         | B     | C     | D     | E     | F     |
| 15 mm.....      | 21.66     | 22.69 | 23.61 | 24.20 | 24.29 | 24.59 |
| 25.....         | 21.65     | 22.76 | 23.64 | 24.17 | 24.30 | 24.64 |
| 35.....         | 21.89     | 22.92 | 23.83 | 24.28 | 24.40 | 24.72 |
| 45.....         | 22.17     | 23.22 | 24.12 | 24.59 | 24.70 | 25.04 |
| 55.....         | 22.60     | 23.56 | 24.42 | 24.89 | 25.01 | 25.34 |
| 65.....         | 22.61     | 23.99 | 24.85 | 25.35 | 25.46 | 25.80 |
| 75.....         | 23.62     | 24.57 | 25.40 | 25.87 | 25.98 | 26.33 |
| 85.....         | 24.47     | 25.31 | 26.13 | 26.57 | 26.68 | 27.02 |
| 94.....         | 24.72     | 26.18 | 26.98 | 27.42 | 27.51 | 27.84 |
| 98.....         | 25.26     | 26.51 | 27.36 | 27.80 | 27.89 | 28.22 |
|                 | G         | H     | I     | L     | M     | N     |
| 15 mm.....      | 24.25     | 23.34 | 22.15 | 28.38 | 28.16 | 28.42 |
| 25.....         | 24.24     | 23.36 | 22.30 | 28.36 | 28.46 | 28.46 |
| 35.....         | 24.36     | 23.57 | 22.48 | 28.51 | 28.53 | 28.60 |
| 45.....         | 24.65     | 23.91 | 22.82 | 28.72 | 28.75 | 28.81 |
| 55.....         | 24.97     | 24.20 | 23.18 | 29.00 | 29.03 | 29.05 |
| 65.....         | 25.43     | 24.67 | 23.65 | 29.26 | 29.36 | 29.41 |
| 75.....         | 25.96     | 25.19 | 24.21 | 29.67 | 29.70 | 29.75 |
| 85.....         | 26.68     | 25.95 | 24.97 | 30.24 | 30.25 | 30.29 |
| 94.....         | 27.51     | 26.79 | 25.20 | 30.85 | 30.87 | 30.92 |
| 98.....         | 27.88     | 27.16 | 25.78 | 31.15 | 31.19 | 31.20 |

TABLE XV.

| Plate. | Best Focus. | Confusion Circle. | Efficiency. |
|--------|-------------|-------------------|-------------|
| A..... | 24.5        | 44.2              | 11.46       |
| B..... | 25.5        | 38.5              | 13.43       |
| C..... | 26.25       | 39.2              | 13.11       |
| D..... | 26.75       | 37.9              | 13.01       |
| E..... | 26.8        | 38.5              | 12.77       |
| F..... | 27.00       | 43.1              | 12.56       |
| G..... | 26.7        | 41.7              | 12.71       |
| H..... | 26.00       | 41.00             | 13.08       |
| I..... | 25.00       | 36.00             | 10.52       |
| L..... | 30.20       | 33.3              | 9.64        |
| M..... | 30.25       | 33.0              | 9.47        |
| N..... | 30.30       | 31.7              | 9.38        |

TABLE XVI.

## ZONAL TEST.

Settings 6·5 &amp; 51·5; Separation 0·132 inches.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. |
|-----------------|--------|--------|--------|--------|-------|
|                 | °      | mm.    | mm.    |        |       |
| 15 mm           | 45     | 0·6422 | 0·7178 | 21·25  |       |
|                 | 135    | 0·6389 | 0·7130 | 21·27  | 21·26 |
| 25              | 0      | 1·0595 | 1·1848 | 21·24  |       |
|                 | 90     | 1·0605 | 1·1895 | 21·21  | 21·22 |
| 35              | 45     | 1·4779 | 1·6885 | 21·00  |       |
|                 | 135    | 1·4683 | 1·6827 | 20·97  | 20·98 |
| 45              | 0      | 1·8743 | 2·1880 | 20·76  |       |
|                 | 90     | 1·8729 | 2·1754 | 20·82  | 20·79 |
| 55              | 45     | 2·2487 | 2·6728 | 20·56  |       |
|                 | 135    | 2·2606 | 2·6841 | 20·57  | 20·56 |
| 65              | 0      | 2·6086 | 3·2090 | 20·18  |       |
|                 | 90     | 2·6180 | 3·2097 | 19·91  | 20·04 |
| 75              | 22·5   | 2·9475 | 3·7395 | 19·83  |       |
|                 | 67·5   | 2·9587 | 3·7468 | 19·86  |       |
|                 | 112·5  | 2·9633 | 3·7468 | 19·87  |       |
|                 | 157·5  | 2·9505 | 3·7495 | 19·82  | 19·84 |
| 85              | 45     | 3·2795 | 4·3160 | 19·43  |       |
|                 | 135    | 3·2858 | 4·3213 | 19·44  | 19·43 |
| 94              | 0      | 3·5285 | 4·8575 | 18·93  |       |
|                 | 90     | 3·5398 | 4·8555 | 18·97  | 18·95 |
| 98              | 22·5   | 3·6505 | 5·0963 | 18·78  |       |
|                 | 67·5   | 3·6643 | 5·0935 | 18·83  |       |
|                 | 112·5  | 3·6723 | 5·0755 | 18·89  |       |
|                 | 157·5  | 3·6566 | 5·0691 | 18·86  | 18·84 |

TABLE XVII.

## ZONAL TEST.

Settings 16·5 &amp; 61·5; Separation 0·070 inches.

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. |
|-----------------|--------|--------|--------|--------|-------|
|                 | °      | mm.    | mm.    |        |       |
| 15 mm           | 45     | 0·6014 | 0·7332 | 20·23  |       |
|                 | 135    | 0·5953 | 0·7372 | 20·10  | 20·16 |
| 25              | 0      | 0·9944 | 1·2348 | 20·07  |       |
|                 | 90     | 0·9931 | 1·2375 | 20·03  | 20·05 |
| 35              | 45     | 1·3921 | 1·7460 | 19·96  |       |
|                 | 135    | 1·3905 | 1·7501 | 19·93  | 19·95 |
| 45              | 0      | 1·7970 | 2·2300 | 20·08  |       |
|                 | 90     | 1·7882 | 2·2236 | 20·06  | 20·07 |
| 55              | 45     | 2·1784 | 2·7251 | 19·99  |       |
|                 | 135    | 2·1720 | 2·7159 | 19·99  | 19·99 |
| 65              | 0      | 2·5940 | 3·2068 | 20·12  |       |
|                 | 90     | 2·5899 | 3·2110 | 20·09  | 20·11 |
| 75              | 22·5   | 2·9884 | 3·6893 | 20·14  |       |
|                 | 67·5   | 2·9855 | 3·6896 | 20·13  |       |
|                 | 112·5  | 2·9914 | 3·6926 | 20·14  |       |
|                 | 157·5  | 2·9865 | 3·6919 | 20·10  | 20·13 |
| 85              | 45     | 3·4127 | 4·1765 | 20·24  |       |
|                 | 135    | 3·4084 | 4·1754 | 20·22  | 20·23 |
| 94              | 0      | 3·7945 | 4·5940 | 20·36  |       |
|                 | 90     | 3·7910 | 4·6020 | 20·33  | 20·35 |
| 98              | 22·5   | 3·9770 | 4·7611 | 20·48  |       |
|                 | 67·5   | 3·9740 | 4·7611 | 20·47  |       |
|                 | 112·5  | 3·9755 | 4·7650 | 20·47  |       |
|                 | 157·5  | 3·9755 | 4·7735 | 20·45  | 20·47 |

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TABLE XVIII.

SETTINGS 16.5 AND 61.5; 0.077 SEPARATION

| Radius of Zone. | $\phi$ | $d_1$  | $d_2$  | Focus. | Mean. |
|-----------------|--------|--------|--------|--------|-------|
|                 | °      | mm.    | mm.    |        |       |
| 15.....         | 45     | 0.5717 | 0.7561 | 19.38  |       |
|                 | 135    | 0.5830 | 0.7540 |        | 19.38 |
| 25.....         | 0      | 0.9550 | 1.2645 | 19.36  |       |
|                 | 90     | 0.9549 | 1.2662 | 19.35  | 19.36 |
| 35.....         | 45     | 1.3335 | 1.7745 | 19.31  |       |
|                 | 135    | 1.3365 | 1.7831 | 19.28  | 19.30 |
| 45.....         | 0      | 1.7208 | 2.2832 | 19.34  |       |
|                 | 90     | 1.7228 | 2.2750 | 19.39  | 19.37 |
| 55.....         | 45     | 2.0918 | 2.7819 | 19.31  |       |
|                 | 135    | 2.0909 | 2.7681 | 19.36  | 19.34 |
| 65.....         | 0      | 2.4909 | 3.2762 | 19.44  |       |
|                 | 90     | 2.4915 | 3.2844 | 19.41  | 19.43 |
| 75.....         | 22.5   | 2.8593 | 3.7774 | 19.39  |       |
|                 | 67.5   | 2.8637 | 3.7804 | 19.39  |       |
|                 | 112.5  | 2.8707 | 3.7829 | 19.42  |       |
|                 | 157.5  | 2.8585 | 3.7694 | 19.41  | 19.40 |
| 85.....         | 45     | 3.2567 | 4.2874 | 19.43  |       |
|                 | 135    | 3.2742 | 4.2702 | 19.53  | 19.48 |
| 94.....         | 0      | 3.6387 | 4.7187 | 19.59  |       |
|                 | 90     | 3.6456 | 4.7240 | 19.60  | 19.60 |
| 98.....         | 22.5   | 3.7929 | 4.9030 | 19.63  |       |
|                 | 67.5   | 3.7942 | 4.9054 | 19.63  |       |
|                 | 112.5  | 3.8191 | 4.8918 |        |       |
|                 | 157.5  | 3.7988 | 4.8958 | 19.66  | 19.64 |



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|        |       |    |    |    |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |   |
|--------|-------|----|----|----|----|----|----|----|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---|
| 12853c | 27    | 15 | 10 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12853d | 27    | 16 | 04 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12860  | 27    | 16 | 09 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12866  | 27    | 16 | 14 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12869a | 27    | 17 | 14 | 24 |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12869b | 27    | 17 | 17 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12890  | 27    | 17 | 17 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12890c | 27    | 17 | 20 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12890d | 27    | 17 | 25 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12900  | 27    | 17 | 28 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12900c | 27    | 17 | 31 | "  |    |    |    |    |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 12906  | Mar.  | 20 | 11 | 51 | 13 | 13 | 1  | 37 | "    | 3.4  | 1.2  | 1.2  | 1.2  | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | P |
| 1405   | "     | 20 | 12 | 07 | 14 | 14 | 2  | 04 | "    | 4.0  | "    | "    | "    | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1407   | "     | 20 | 12 | 21 | 13 | 13 | 2  | 04 | "    | 4.3  | "    | "    | "    | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1408   | "     | 20 | 12 | 32 | 11 | 2  | 15 | 0  | "    | 4.3  | 1.1  | 1.1  | 1.1  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1409   | "     | 20 | 12 | 46 | 14 | 2  | 30 | 0  | "    | 5.2  | 1.0  | 1.0  | 1.0  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1410   | "     | 20 | 13 | 00 | 11 | 2  | 45 | "  | "    | 6.0  | "    | "    | "    | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1411   | "     | 20 | 13 | 12 | 9  | 2  | 52 | "  | 6.5  | 1.0  | 0.9  | 0.9  | 0.9  | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | P |
| 1412   | "     | 20 | 13 | 25 | 15 | 3  | 10 | "  | 6.5  | 0.9  | 0.8  | 0.8  | 0.8  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1413   | "     | 20 | 13 | 47 | 8  | 3  | 30 | "  | 6.8  | 7.0  | 0.8  | 0.8  | 0.8  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1414   | "     | 20 | 13 | 57 | 11 | 3  | 40 | "  | 7.0  | "    | "    | "    | "    | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1426a  | "     | 24 | 12 | 03 | 10 | 2  | 02 | "  | 1.0  | 1.0  | 5.1  | 5.1  | 5.1  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | P |
| 1427   | "     | 24 | 12 | 14 | 8  | 2  | 12 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1428   | "     | 24 | 12 | 23 | 8  | 2  | 20 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1429   | "     | 24 | 12 | 32 | 9  | 2  | 30 | "  | 2.0  | 5.0  | 5.0  | 5.0  | 5.0  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1430   | "     | 24 | 12 | 42 | 9  | 2  | 40 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1431   | "     | 24 | 12 | 52 | 8  | 2  | 50 | "  | 3.4  | 4.9  | 4.9  | 4.9  | 4.9  | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |
| 1433   | "     | 24 | 13 | 16 | 7  | 3  | 15 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1434   | "     | 24 | 13 | 22 | 6  | 3  | 30 | "  | 4.5  | 4.7  | 4.7  | 4.7  | 4.7  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | P |
| 1435   | "     | 24 | 13 | 39 | 6  | 3  | 36 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1436   | "     | 24 | 13 | 46 | 6  | 3  | 44 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1437   | "     | 24 | 13 | 56 | 9  | 3  | 56 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1438   | "     | 24 | 14 | 07 | 10 | 4  | 05 | "  | 5.0  | 5.0  | 4.6  | 4.6  | 4.6  |       |       |       |       |       |       |       |       |       |       |       | P |
| 1439   | "     | 30 | 12 | 19 | 8  | 2  | 40 | "  | 3.5  | 3.5  | 5.7  | 5.7  | 5.7  | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | P |
| 1440   | "     | 30 | 12 | 29 | 8  | 2  | 50 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1441   | "     | 30 | 12 | 38 | 9  | 3  | 00 | "  | 3.5  | 3.3  | 3.7  | 3.7  | 3.7  | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | 0.022 | P |
| 1442   | "     | 30 | 12 | 49 | 10 | 3  | 13 | "  | 3.3  | 3.0  | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1448   | April | 3  | 12 | 16 | 9  | 2  | 57 | "  | 2.8  | 3.2  | 1.7  | 1.7  | 1.7  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | P |
| 1449   | "     | 3  | 12 | 28 | 10 | 3  | 10 | "  | 3.2  | 3.8  | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1450   | "     | 3  | 12 | 40 | 10 | 3  | 22 | "  | 3.4  | 3.4  | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1451   | "     | 3  | 12 | 53 | 10 | 3  | 35 | "  | 3.4  | 3.1  | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1457   | "     | 4  | 12 | 19 | 8  | 3  | 00 | "  | 1.6  | 2.0  | 2.0  | 2.0  | 2.0  | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 | P |
| 1458   | "     | 4  | 12 | 28 | 8  | 3  | 10 | "  | 2.0  | "    | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1459   | "     | 4  | 12 | 37 | 8  | 3  | 20 | "  | 2.0  | "    | "    | "    | "    |       |       |       |       |       |       |       |       |       |       |       | P |
| 1469   | "     | 13 | 12 | 10 | 10 | 3  | 30 | "  | 5.8  | 9.7  | 9.7  | 9.7  | 9.7  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | P |
| 1470   | "     | 13 | 12 | 22 | 10 | 3  | 42 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1471   | "     | 13 | 12 | 34 | 11 | 3  | 53 | "  |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       | P |
| 1873   | Sept. | 7  | 21 | 52 | 16 | 0  | 45 | "  | 12.0 | 11.8 | 21.0 | 21.0 | 21.0 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | C |
| 1874   | "     | 7  | 22 | 10 | 19 | 0  | 45 | "  | 11.8 | 11.6 | 11.7 | 11.7 | 11.7 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | C |
| 1935   | "     | 13 | 21 | 19 | 20 | 0  | 45 | "  | 7.6  | 7.6  | 11.6 | 11.6 | 11.6 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | C |
| 1936   | Oct.  | 13 | 21 | 21 | 21 | 1  | 20 | "  | 7.6  | "    | 11.6 | 11.6 | 11.6 | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | "     | P |

Off part of time.

Shit intended for '001's.

III

$\beta$  ORIONIS.  
RECORD OF SPECTROGRAMS—Continued.

P. Plaskett.  
H. Harper.  
C. Cannon.  
P. F. Parker.

| Star.              | No. of Negative. | Camera. | Plate.   | Date.    | Middle of Exposure (G. M. T.). | Duration. | Hour Angle at end. | TEMPERATURE CENTIGRADE. |            |        |      | Slit Width. | Seeing. | Observer. | Remarks.  |
|--------------------|------------------|---------|----------|----------|--------------------------------|-----------|--------------------|-------------------------|------------|--------|------|-------------|---------|-----------|-----------|
|                    |                  |         |          |          |                                |           |                    | Room.                   | Prism Box. | Begin. | End. |             |         |           |           |
| $\beta$ Orionis... | 1937             | HL      | Seed 27. | 1908.    | h. m.                          | m.        | h. m.              | Begin.                  | End.       | Begin. | End. |             |         |           |           |
| "                  | 1938             | "       | "        | Oct. 13. | 22 19                          | 30        | 1 50 W.            | 7.6                     | 7.6        | 11.6   | 11.6 | 0016        | Fair.   | P.        |           |
| "                  | 1978             | "       | "        | "        | 22 47                          | 25        | "                  | 7.5                     | 7.5        | "      | "    | "           | "       | P.        |           |
| "                  | 1978             | "       | "        | Nov. 21. | 18 24                          | 18        | 0 25 "             | 2.7                     | 2.6        | 4.9    | 4.9  | 0015        | "       | P.        |           |
| "                  | 1979             | "       | "        | "        | 18 43                          | 17        | 0 45 "             | 2.6                     | 1.5        | "      | "    | "           | "       | P.        |           |
| "                  | 1980             | "       | "        | "        | 19 05                          | 22        | 1 10 "             | 1.4                     | 0.3        | "      | 4.8  | "           | "       | P.        |           |
| "                  | 1981             | "       | "        | "        | 19 33                          | 30        | 1 40 "             | 0.3                     | 1.5        | 4.8    | 6.7  | 0016        | "       | P.        | Fog.      |
| "                  | 1984             | "       | "        | "        | 16 05                          | 29        | 1 30 E.            | 5.2                     | 5.0        | 6.7    | 6.7  | "           | "       | P.        |           |
| "                  | 1985             | "       | "        | "        | 16 34                          | 22        | 1 00 "             | 5.0                     | 5.5        | "      | "    | "           | "       | P.        |           |
| "                  | 1986             | "       | "        | "        | 17 08                          | 15        | 0 10 "             | 5.5                     | "          | "      | "    | "           | "       | P.        |           |
| "                  | 1987             | "       | "        | Dec. 28. | 17 53                          | 27        | 0 35 W.            | 4.0                     | 4.0        | 1.8    | 1.8  | "           | Good    | P.        |           |
| "                  | 1988             | "       | "        | "        | 18 18                          | 16        | 1 00 "             | 4.0                     | 4.1        | "      | "    | "           | "       | P.        |           |
| "                  | 1989             | "       | "        | "        | 18 36                          | 16        | 1 18 "             | 4.1                     | 4.2        | "      | "    | "           | "       | P.        |           |
| "                  | 1990             | "       | "        | "        | 18 52                          | 15        | 1 31 "             | 4.2                     | 4.5        | "      | "    | "           | "       | P.        |           |
| "                  | 2003             | "       | "        | "        | 16 10                          | 10        | 1 00 E.            | 16.0                    | 16.5       | 7.9    | 7.9  | "           | Fair.   | P.        |           |
| "                  | 2004             | "       | "        | "        | 16 22                          | 10        | 0 48 "             | "                       | "          | "      | "    | 0016        | "       | P.        |           |
| "                  | 2005             | "       | "        | "        | 16 38                          | 13        | 0 32 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2006             | "       | "        | "        | 16 53                          | 13        | 0 15 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2054             | HL      | "        | "        | 15 24                          | 3         | 0 21 "             | 11.2                    | 11.2       | 1.6    | 1.6  | 0015        | Good.   | P.        |           |
| "                  | 2055             | "       | "        | "        | 15 29                          | 2         | 0 29 W.            | "                       | "          | 1.9    | 1.9  | "           | "       | P.        |           |
| "                  | 2057             | "       | "        | "        | 16 54                          | 2         | 0 45 W.            | 12.4                    | 12.4       | "      | "    | "           | "       | P.        |           |
| "                  | 2058             | "       | "        | "        | 17 00                          | 2         | 0 51 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2065             | HL      | "        | "        | 17 38                          | 10        | 1 20 "             | 18.5                    | "          | 13.0   | "    | 0016        | "       | P.        |           |
| "                  | 2066             | "       | "        | "        | 17 52                          | 9         | 1 32 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2067             | "       | "        | "        | 18 02                          | 8         | 1 43 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2068             | "       | "        | "        | 18 14                          | 8         | 2 10 "             | "                       | "          | "      | 13.0 | "           | "       | P.        |           |
| "                  | 2070             | "       | "        | "        | 14 01                          | 14        | 1 55 E.            | 14.5                    | 14.5       | 7.5    | 7.5  | "           | "       | P.        |           |
| "                  | 2071             | "       | "        | "        | 14 41                          | 14        | 1 00 "             | 16.0                    | 15.0       | 7.8    | 7.9  | "           | Poor.   | H. P.     | Drifting. |
| "                  | 2072             | "       | "        | "        | 15 08                          | 8         | 0 50 "             | "                       | "          | 7.9    | "    | "           | "       | P.        |           |
| "                  | 2073             | "       | "        | "        | 15 19                          | 8         | 0 40 "             | "                       | "          | "      | "    | "           | "       | P.        |           |
| "                  | 2075             | "       | "        | "        | 15 49                          | 8         | 0 00 "             | 9.8                     | "          | 4.1    | "    | "           | Steady. | P.        |           |



## SESSIONAL PAPER No. 25a

| Date  | Time | W.             | E. | Lat. | Long. | Alt.  | Dist. | Di. Circ. | Wind  | Bar.  | Therm. | Moon  | Remarks | Notes     |
|-------|------|----------------|----|------|-------|-------|-------|-----------|-------|-------|--------|-------|---------|-----------|
| 2076  | "    | 8              | 0  | 20   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2077  | "    | 8              | 0  | 20   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2078  | "    | 8              | 0  | 30   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2079  | "    | 20             | 1  | 30   | E.    | 0-0   | 0-0   | 0-1       | 0-1   | 0-1   | 0-1    | 0-1   | Hazy    | "         |
| 2080  | "    | 15             | 0  | 20   | "     | 0-5   | 0-5   | 0-5       | 0-5   | 0-5   | 0-5    | 0-5   | Poor    | "         |
| 2082  | 11   | 2              | 0  | 06   | "     | -10-0 | -13-5 | -3-3      | -3-3  | -3-3  | -3-3   | -3-3  | 0015    | "         |
| 2083  | "    | 2 <sup>3</sup> | 0  | 02   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2084  | "    | 3              | 0  | 02   | W.    | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2085  | "    | 5              | 0  | 31   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 1909. |      |                |    |      |       |       |       |           |       |       |        |       |         |           |
| 2092  | "    | 2              | 1  | 36   | W.    | -16-5 | -2-8  | -2-8      | -2-8  | -2-8  | -2-8   | -2-8  | 0015    | Good.     |
| 2093  | "    | 2              | 1  | 40   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2094  | "    | 2              | 2  | 00   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2095  | "    | 2              | 2  | 04   | E.    | -17-5 | -3-1  | -3-1      | -3-1  | -3-1  | -3-1   | -3-1  | "       | "         |
| 2105  | "    | 2              | 2  | 15   | E.    | -16-3 | -9-2  | -9-2      | -9-2  | -9-2  | -9-2   | -9-2  | "       | Poor      |
| 2106  | "    | 2              | 2  | 03   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2107  | "    | 2              | 2  | 00   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2108  | "    | 2              | 1  | 57   | "     | -16-4 | -9-2  | -9-2      | -9-2  | -9-2  | -9-2   | -9-2  | "       | "         |
| 2111  | "    | 7              | 1  | 20   | W.    | -18-0 | -13-3 | -13-3     | -13-3 | -13-3 | -13-3  | -13-3 | 0016    | Fair      |
| 2112  | "    | 7              | 1  | 30   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2114  | "    | 7              | 1  | 55   | "     | -18-0 | -13-3 | -13-3     | -13-3 | -13-3 | -13-3  | -13-3 | "       | "         |
| 2117  | 11   | 8              | 1  | 00   | "     | -11-6 | -8-9  | -8-9      | -8-9  | -8-9  | -8-9   | -8-9  | 0015    | Good      |
| 2118  | "    | 8              | 1  | 52   | "     | -11-6 | -8-9  | -8-9      | -8-9  | -8-9  | -8-9   | -8-9  | 0015    | "         |
| 2122  | "    | 12             | 1  | 04   | "     | -11-6 | -6-8  | -6-8      | -6-8  | -6-8  | -6-8   | -6-8  | 0013    | Poor      |
| 2123  | "    | 12             | 2  | 50   | E.    | -9-0  | -6-8  | -6-8      | -6-8  | -6-8  | -6-8   | -6-8  | "       | "         |
| 2124  | "    | 12             | 2  | 46   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2125  | "    | 2              | 2  | 36   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2126  | "    | 2              | 2  | 33   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2127  | "    | 2              | 2  | 30   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2128  | "    | 2              | 2  | 27   | "     | -11-5 | -6-9  | -6-9      | -6-9  | -6-9  | -6-9   | -6-9  | "       | "         |
| 2129  | "    | 2              | 2  | 55   | W.    | -15-0 | -12-0 | -12-0     | -12-0 | -12-0 | -12-0  | -12-0 | 0013    | "         |
| 2130  | "    | 2              | 1  | 06   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2131  | "    | 2              | 1  | 06   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2141  | "    | 15             | 0  | 19   | "     | -14-8 | -4-7  | -4-7      | -4-7  | -4-7  | -4-7   | -4-7  | "       | "         |
| 2142  | "    | 15             | 0  | 36   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2143  | "    | 15             | 0  | 40   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2144  | "    | 15             | 0  | 47   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2151  | "    | 16             | 2  | 00   | E.    | -21-5 | -15-6 | -5-2      | -5-2  | -5-2  | -5-2   | -5-2  | 0010    | Very hazy |
| 2152  | "    | 10             | 2  | 00   | E.    | -21-5 | -21-5 | -12-0     | -12-0 | -12-0 | -12-0  | -12-0 | "       | 1-better. |
| 2153  | "    | 7              | 1  | 49   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2154  | "    | 4              | 1  | 41   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2155  | "    | 5              | 1  | 33   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2156  | "    | 6              | 1  | 26   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2157  | "    | 16             | 1  | 10   | "     | -22-0 | -12-0 | -12-0     | -12-0 | -12-0 | -12-0  | -12-0 | 0015    | Good.     |
| 2158  | "    | 17             | 13 | 48   | "     | -13-5 | -11-8 | -11-8     | -11-8 | -11-8 | -11-8  | -11-8 | "       | "         |
| 2161  | "    | 18             | 12 | 41   | "     | -17-5 | -13-8 | -13-8     | -13-8 | -13-8 | -13-8  | -13-8 | "       | "         |
| 2162  | "    | 18             | 12 | 46   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2163  | "    | 18             | 12 | 51   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |
| 2164  | "    | 18             | 13 | 04   | "     | "     | "     | "         | "     | "     | "      | "     | "       | "         |

Only 5m. seeing.

Focus as Jan. 12.

Focus unchanged.

β ORIONIS.  
RECORD OF SPECTROGRAMS. — *Continued.*

P.—Plaskett,  
H.—Harper,  
C.—Cannon,  
P.—Parker.

| Star.         | No. of Negative. | Camera. | Plate.     | Date.          | Middle of Exposure, G. M. T. | Duration. | Hour, Angle at End. | TEMPERATURE CENTIGRADE. |            |             |       | Slit Width.     | Seeing. | Observer. | Remarks. |
|---------------|------------------|---------|------------|----------------|------------------------------|-----------|---------------------|-------------------------|------------|-------------|-------|-----------------|---------|-----------|----------|
|               |                  |         |            |                |                              |           |                     | Room.                   | Prism Box. | Begin-ning. | End.  |                 |         |           |          |
| β Orionis.... | 2165             | HL      | Seed 27... | 1909, Jan. 18. | h. m.                        | m.        | h. m.               | Begin-ning.             | End.       | Begin-ning. | End.  | 0.015           |         | P         |          |
| "             | 2166             | "       | "          | " 18.          | 13 10                        | 2         | 1 08                | -19 5                   |            |             | -13 8 |                 |         | P         |          |
| "             | 2177             | "       | "          | " 26.          | 10 36                        | 3         | 3 10                | + 1 8                   |            |             |       | 0.013 Good.     |         | P         |          |
| "             | 2178             | "       | "          | " 26.          | 10 51                        | 3         | 2 55                |                         |            |             |       | "               |         | P         |          |
| "             | 2179             | "       | "          | " 26.          | 10 56                        | 3         | 2 50                |                         |            |             |       | "               |         | P         |          |
| "             | 2180             | "       | "          | " 26.          | 11 01                        | 3         | 2 45                |                         |            |             |       | "               |         | P         |          |
| "             | 2181             | "       | "          | " 26.          | 11 11                        | 2         | 2 35                |                         |            |             |       | "               |         | P         |          |
| "             | 2182             | "       | "          | " 26.          | 11 16                        | 3         | 2 30                |                         |            |             |       | "               |         | P         |          |
| "             | 2183             | "       | "          | " 26.          | 11 21                        | 2         | 2 25                | - 1 6                   |            | + 1 8       |       | "               |         | P         |          |
| "             | 2184             | "       | "          | " 28.          | 11 21                        | 3         | 2 20                | - 8 3                   |            | - 6 9       |       | "               |         | P         |          |
| "             | 2185             | "       | "          | " 28.          | 11 25                        | 3         | 2 16                |                         |            |             |       | "               |         | P         |          |
| "             | 2186             | "       | "          | " 28.          | 11 29                        | 3         | 2 12                |                         |            |             |       | "               |         | P         |          |
| "             | 2187             | "       | "          | " 28.          | 11 31                        | 2         | 2 00                |                         |            |             |       | "               |         | P         |          |
| "             | 2188             | "       | "          | " 28.          | 11 44                        | 2         | 1 57                |                         |            |             |       | "               |         | P         |          |
| "             | 2189             | "       | "          | " 28.          | 11 47                        | 2         | 1 55                | - 9 0                   |            | - 6 9       |       | "               |         | P         |          |
| "             | 2195             | "       | "          | " 29.          | 12 53                        | 2         | 0 40                | 6 4                     |            | 0 0         |       | "               |         | C         |          |
| "             | 2196             | "       | "          | " 29.          | 12 57                        | 3         | 0 38                |                         |            |             |       | "               |         | C         |          |
| "             | 2197             | "       | "          | " 29.          | 13 01                        | 3         | 0 34                |                         |            |             |       | "               |         | C         |          |
| "             | 2198             | "       | "          | " 29.          | 13 05                        | 3         | 0 30                | - 6 4                   |            |             | 0 0   | "               | Fair.   | C         |          |
| "             | 2201             | "       | "          | " 30.          | 12 29                        | 2         | 1 00                |                         |            |             |       | "               | "       | P         |          |
| "             | 2202             | "       | "          | " 30.          | 12 41                        | 2         | 0 48                |                         |            |             |       | "               | "       | P         |          |
| "             | 2203             | "       | "          | " 30.          | 12 45                        | 2         | 0 45                |                         |            |             |       | "               | "       | P         |          |
| "             | 2204             | "       | "          | " 30.          | 12 48                        | 2         | 0 42                | - 6 0                   |            | - 2 7       | - 2 6 | "               | "       | P         |          |
| "             | 2205             | HL      | "          | " 30.          | 13 47                        | 14        | 2 20 W.             |                         |            |             |       | 0.016 Unsteady. |         | P         |          |
| "             | 2206             | "       | "          | " 30.          | 16 04                        | 16        | 2 37                |                         |            |             |       | "               |         | P         |          |
| "             | 2207             | "       | "          | " 30.          | 16 24                        | 19        | 3 00                | - 6 6                   |            | - 2 8       |       | "               |         | P         |          |
| "             | 2211             | HL      | "          | " 31.          | 17 16                        | 3         | 3 32                | -19 0                   |            | - 6 0       |       | 0.013 Fair.     |         | H         |          |
| "             | 2212             | "       | "          | " 31.          | 17 20                        | 3         | 3 36                | -19 0                   |            | - 6 0       |       | "               |         | H         |          |
| "             | 2213             | "       | "          | " 31.          | 17 24                        | 5         | 3 40                |                         |            |             |       | "               |         | H         |          |
| "             | 2214             | "       | "          | " 31.          | 17 29                        | 5         | 3 45                | -19 0                   |            |             | - 6 0 | "               |         | H         |          |

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| 2215  | " | " | " | Feb. | 11 | 14 | 2  | 2  | 05 | 6  | 6      | 27    | "     | "           | 0012 | " | P |
|-------|---|---|---|------|----|----|----|----|----|----|--------|-------|-------|-------------|------|---|---|
| 2216  | " | " | " | "    | 11 | 23 | 1  | 1  | 56 | "  | "      | "     | "     | "           | "    | " | P |
| 2217  | " | " | " | "    | 11 | 26 | 2  | 1  | 53 | "  | "      | "     | "     | "           | "    | " | P |
| 2218  | " | " | " | "    | 2  | 11 | 2  | 1  | 50 | "  | "      | "     | "     | "           | "    | " | P |
| 2219  | " | " | " | "    | 2  | 11 | 2  | 1  | 38 | "  | "      | "     | "     | "           | "    | " | P |
| 2220  | " | " | " | "    | 2  | 11 | 2  | 1  | 38 | "  | - 7.1  | - 1.9 | "     | "           | "    | " | P |
| 2220  | " | " | " | "    | 2  | 11 | 2  | 2  | 37 | "  | - 4.0  | "     | "     | "           | "    | " | P |
| 22236 | " | " | " | "    | 6  | 12 | 2  | 2  | 16 | "  | "      | "     | "     | "           | "    | " | P |
| 22239 | " | " | " | "    | 6  | 12 | 1  | 1  | 15 | "  | "      | "     | "     | "           | "    | " | P |
| 22340 | " | " | " | "    | 6  | 12 | 25 | 3  | 20 | W. | "      | "     | "     | "           | "    | " | P |
| 2241  | " | " | " | "    | 6  | 16 | 12 | 3  | 55 | "  | - 3.8  | - 3.0 | "     | 0016        | "    | P |   |
| 2242  | " | " | " | "    | 6  | 16 | 43 | 3  | 55 | "  | - 3.5  | "     | "     | "           | "    | P |   |
| 2243  | " | " | " | "    | 7  | 15 | 11 | 2  | 25 | "  | 2.5    | - 1.2 | "     | "           | "    | P |   |
| 2244  | " | " | " | "    | 7  | 15 | 25 | 2  | 28 | "  | 3.5    | - 1.2 | "     | "           | "    | P |   |
| 2245  | " | " | " | "    | 7  | 15 | 37 | 10 | 2  | "  | "      | "     | "     | "           | "    | P |   |
| 2249  | " | " | " | "    | 8  | 13 | 32 | 2  | 39 | "  | - 13.5 | - 5.2 | "     | 0012 (Good) | "    | P |   |
| 2250  | " | " | " | "    | 8  | 13 | 36 | 2  | 42 | "  | "      | "     | "     | "           | "    | P |   |
| 2251  | " | " | " | "    | 8  | 13 | 41 | 2  | 47 | "  | "      | "     | "     | "           | "    | P |   |
| 2252  | " | " | " | "    | 8  | 14 | 01 | 2  | 1  | 07 | "      | "     | "     | "           | "    | P |   |
| 2253  | " | " | " | "    | 8  | 14 | 05 | 2  | 1  | 11 | "      | "     | "     | "           | "    | P |   |
| 2254  | " | " | " | "    | 8  | 14 | 09 | 2  | 1  | 15 | "      | "     | "     | "           | "    | P |   |
| 2265  | " | " | " | "    | 10 | 12 | 07 | 4  | 45 | E. | - 4.0  | - 1.8 | "     | 0011 Poor   | "    | P |   |
| 2266  | " | " | " | "    | 10 | 12 | 12 | 3  | 40 | "  | "      | "     | "     | "           | "    | P |   |
| 2267  | " | " | " | "    | 10 | 12 | 16 | 2  | 36 | "  | "      | "     | "     | "           | "    | P |   |
| 2268  | " | " | " | "    | 10 | 12 | 21 | 2  | 31 | "  | "      | "     | "     | "           | "    | P |   |
| 2269  | " | " | " | "    | 10 | 12 | 24 | 2  | 31 | "  | "      | "     | "     | "           | "    | P |   |
| 2270  | " | " | " | "    | 10 | 12 | 33 | 2  | 19 | "  | "      | "     | "     | "           | "    | P |   |
| 2271  | " | " | " | "    | 10 | 12 | 37 | 2  | 10 | "  | - 4.6  | - 2.2 | "     | 0012 (Good) | "    | P |   |
| 2272  | " | " | " | "    | 11 | 11 | 26 | 2  | 10 | "  | - 7.5  | - 2.9 | "     | "           | "    | P |   |
| 2273  | " | " | " | "    | 11 | 11 | 32 | 2  | 17 | E. | "      | "     | "     | "           | "    | P |   |
| 2274  | " | " | " | "    | 11 | 11 | 35 | 2  | 14 | "  | "      | "     | "     | "           | "    | P |   |
| 2275  | " | " | " | "    | 11 | 11 | 38 | 2  | 14 | "  | "      | "     | "     | "           | "    | P |   |
| 2276  | " | " | " | "    | 11 | 11 | 38 | 2  | 11 | "  | "      | "     | "     | "           | "    | P |   |
| 2277  | " | " | " | "    | 11 | 11 | 46 | 2  | 1  | 03 | "      | "     | "     | "           | "    | P |   |
| 2278  | " | " | " | "    | 11 | 11 | 49 | 2  | 1  | 00 | "      | "     | "     | "           | "    | P |   |
| 2279  | " | " | " | "    | 13 | 12 | 27 | 10 | 05 | "  | - 4.5  | + 0.1 | "     | 0016 Fair   | "    | P |   |
| 2280  | " | " | " | "    | 13 | 12 | 40 | 10 | 08 | W. | "      | "     | "     | "           | "    | P |   |
| 2281  | " | " | " | "    | 13 | 12 | 53 | 10 | 21 | "  | - 5.0  | + 3.8 | "     | "           | "    | P |   |
| 2284  | " | " | " | "    | 20 | 12 | 29 | 18 | 25 | "  | - 1.3  | + 3.8 | "     | 0015        | "    | P |   |
| 2285  | " | " | " | "    | 20 | 13 | 05 | 50 | 1  | 20 | "      | - 2.3 | + 3.6 | "           | "    | P |   |
| 2286  | " | " | " | "    | 20 | 15 | 12 | 15 | 3  | 10 | "      | - 3.4 | + 3.3 | "           | "    | P |   |
| 2288  | " | " | " | "    | 21 | 12 | 57 | 9  | 55 | "  | 1.6    | + 4.3 | "     | "           | "    | P |   |
| 2289  | " | " | " | "    | 21 | 13 | 07 | 9  | 1  | 05 | "      | "     | "     | "           | "    | P |   |
| 2290  | " | " | " | "    | 21 | 13 | 17 | 9  | 1  | 15 | "      | "     | "     | "           | "    | P |   |
| 2291  | " | " | " | "    | 21 | 13 | 28 | 9  | 1  | 25 | "      | - 2.4 | + 4.2 | "           | "    | P |   |
| 2292  | " | " | " | "    | 22 | 12 | 02 | 10 | 10 | "  | - 0.8  | 3.0   | "     | "           | "    | P |   |
| 2293  | " | " | " | "    | 22 | 12 | 15 | 10 | 20 | "  | 1.0    | 2.9   | "     | "           | "    | P |   |
| 2294  | " | " | " | "    | 22 | 12 | 30 | 10 | 35 | "  | "      | "     | "     | "           | "    | P |   |
| 2295  | " | " | " | "    | 22 | 12 | 42 | 9  | 47 | "  | "      | "     | "     | "           | "    | P |   |
| 2300  | " | " | " | "    | 25 | 11 | 32 | 25 | 03 | "  | 1.5    | 5.0   | "     | 0015        | "    | P |   |
| 2311  | " | " | " | "    | 28 | 11 | 56 | 8  | 28 | "  | - 6.8  | - 1.2 | "     | "           | "    | P |   |
| 2312  | " | " | " | "    | 28 | 12 | 07 | 10 | 30 | "  | "      | "     | "     | "           | "    | P |   |
| 2313  | " | " | " | "    | 28 | 12 | 18 | 7  | 41 | "  | "      | "     | "     | "           | "    | P |   |

Cloudy 2/3 time.

Very windy.

Very cloudy.

β ORIONIS.  
RECORD OF SPECTROGRAMS.—Continued.

P.—Plaskett.  
H.—Harper.  
C.—Cannon.  
P.—Parker.

| Star.        | No. of Negative. | Camera. | Plate.  | Date.         | Middle of Exposure, G. M. T. | Duration. | Hour Angle at End. |      | TEMPERATURE CENTIGRADE. |            |        |      | Slit Width. | Seeing. | Observer. | Remarks. |
|--------------|------------------|---------|---------|---------------|------------------------------|-----------|--------------------|------|-------------------------|------------|--------|------|-------------|---------|-----------|----------|
|              |                  |         |         |               |                              |           | h.                 | m.   | Room.                   | Prism Box. | Begin. | End. |             |         |           |          |
| β Orionis... | 2314             | "       | Seed 27 | 1909, Feb. 28 | 12 27                        | 7         | 1 50 W.            |      |                         |            |        | 0015 | Good        | P       |           |          |
| "            | 2315             | "       | "       | " 28          | 12 39                        | 12        | 1 02 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2316             | "       | "       | " 28          | 12 50                        | 8         | 1 15 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2317             | "       | "       | Mar. 2        | 11 05                        | 10        | 22 E.              | 0.3  | 3.6                     |            |        | 0016 | "           | P       |           |          |
| "            | 2318             | "       | "       | " 2           | 11 19                        | 8         | 8 "                |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2319             | "       | "       | " 2           | 11 29                        | 8         | 2 W.               |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2320             | "       | "       | " 2           | 11 39                        | 8         | 10 "               | 1.0  | 3.6                     |            |        | 0015 | "           | P       |           |          |
| "            | 2364             | "       | "       | " 13          | 12 12                        | 8         | 1 28 "             | 2.8  | 7.2                     |            |        | "    | "           | P       |           |          |
| "            | 2365             | "       | "       | " 13          | 12 21                        | 8         | 1 40 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2366             | "       | "       | " 13          | 12 36                        | 8         | 1 52 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2367             | "       | "       | " 13          | 12 46                        | 7         | 2 02 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2368             | "       | "       | " 13          | 12 57                        | 6         | 2 10 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2372             | "       | "       | " 15          | 11 45                        | 10        | 1 10 "             | -0.4 | 2.0                     |            |        | "    | "           | P       |           |          |
| "            | 2373             | "       | "       | " 15          | 11 56                        | 7         | 1 21 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2374             | "       | "       | " 15          | 12 05                        | 6         | 1 30 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2375             | "       | "       | " 15          | 12 13                        | 6         | 1 35 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2376             | "       | "       | " 15          | 12 21                        | 6         | 1 40 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2386             | "       | "       | " 18          | 11 42                        | 9         | 1 50 "             | 0.4  | 3.8                     |            |        | "    | "           | P       |           |          |
| "            | 2387             | "       | "       | " 18          | 11 52                        | 7         | 1 30 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2388             | "       | "       | " 18          | 12 02                        | 8         | 1 40 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2389             | "       | "       | " 18          | 12 12                        | 7         | 1 50 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2390             | "       | "       | " 20          | 12 16                        | 7         | 1 00 "             | 11.0 | 7.2                     |            |        | "    | Fair        | P       |           |          |
| "            | 2391             | "       | "       | " 20          | 12 26                        | 7         | 1 10 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2392             | "       | "       | " 20          | 12 38                        | 10        | 1 22 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2393             | "       | "       | " 20          | 12 48                        | 7         | 1 30 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2394             | "       | "       | " 20          | 12 58                        | 7         | 1 40 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2397             | "       | "       | " 21          | 13 38                        | 8         | 3 25 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2398             | "       | "       | " 21          | 13 48                        | 9         | 3 35 "             | -1.8 | 4.0                     |            |        | "    | "           | P       |           |          |
| "            | 2399             | "       | "       | " 21          | 14 00                        | 11        | 3 47 "             |      |                         |            |        | "    | "           | P       |           |          |
| "            | 2400             | "       | "       | " 21          | 14 14                        | 12        | 4 02 "             |      |                         |            |        | "    | "           | P       |           |          |

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|      |       |    |      |       |       |       |           |   |
|------|-------|----|------|-------|-------|-------|-----------|---|
| 2402 | 11 51 | 10 | 1 31 | 3 1   | 4 8   | 4 8   | Good..... | P |
| 2403 | 12 02 | 10 | 1 42 | ..... | ..... | ..... | "         | P |
| 2404 | 12 13 | 11 | 1 51 | ..... | ..... | ..... | "         | P |
| 2405 | 12 35 | 9  | 2 15 | ..... | 2 6   | 4 8   | "         | P |
| 2420 | 11 46 | 6  | 1 40 | 5 4   | 8 1   | ..... | "         | P |
| 2421 | 11 57 | 6  | 1 51 | ..... | ..... | ..... | "         | P |
| 2422 | 12 05 | 6  | 1 39 | ..... | ..... | ..... | "         | P |
| 2423 | 12 13 | 7  | 2 07 | ..... | ..... | ..... | "         | P |
| 2424 | 12 27 | 8  | 2 20 | ..... | ..... | ..... | "         | C |
| 2425 | 12 38 | 8  | 2 33 | ..... | 3 5   | 6 8   | "         | C |

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1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 00<sup>m</sup> $\beta$  ORIONIS 1241 *a*.Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 0256           |                          |  |           | 1½  | 53 1058           |                          |  |           |
| 3   | 53 0008           | 0048                     | 0350                                   | +40 28    | 3   | 45 2624           | 2724                     | 0337                                   | +55 17    |
| 2   | 53 4440           | 4490                     | 0467                                   | 53 40     | 2   | 45 2628           |                          |  |           |

Weighted mean. .... +41 64  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature..... - 28  
 Radial velocity..... + 23 3

1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 00<sup>m</sup> $\beta$  ORIONIS 1241 *b*.Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7354           |                          |  |           | 2   | 53 1094           |                          |  |           |
| 2   | 54 0270           |                          |  |           | 3   | 45 2712           | 2755                     | 0368                                   | +38 41    |
| 3   | 54 0008           | 0048                     | 0350                                   | +40 28    | 2   | 45 2684           |                          |  |           |
| 1   | 53 4328           | 4360                     | 0357                                   | +38 54    |     |                   |                          |  |           |

Weighted mean. .... +39 23  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature..... - 28  
 Radial velocity..... + 20 9

1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 00<sup>m</sup> $\beta$  ORIONIS 1241 *c*.Measured by } J. S. PLASKETT.  
Observed by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
|     | 54 7640           |                          |  |           |     | 53 1358           |                          |  |           |
|     | 54 0552           |                          |  |           |     | 45 2960           |                          |  |           |
| 2   | 54 0360           | 0130                     | 0448                                   | +51 56    | 3   | 45 2952           | 2727                     | 0340                                   | +35 49    |
| 1   | 53 4715           | 4485                     | 0462                                   | +52 83    |     |                   |                          |  |           |

Weighted mean. .... +43 74  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature..... - 28  
 Radial velocity..... + 25 4

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1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

$\beta$  ORIONIS 1217 *a*.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7385           |                          |  |           | 2   | 53 1954           |                          |  |           |
| 2   | 54 0270           |                          |  |           | 2   | 45 2652           | 2737                     | 0350                                   | +36 53    |
| 3   | 54 0012           | 0052                     | 0354                                   | +40 74    | 2   | 45 2653           |                          |  |           |
| 3   | 53 4384           | 4434                     | 0411                                   | +47 00    |     |                   |                          |  |           |

Weighted mean..... +42 03  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... - 28  
 Radial velocity..... + 23 7

1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

$\beta$  ORIONIS 1242 *b*.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7430           |                          |  |           | 2   | 53 1110           |                          |  |           |
| 1               | 54 0320           |                          |  |           | 3   | 45 2740           | 2783                     | 0396                                   | +41 34    |
| 2 $\frac{1}{2}$ | 54 0078           | 0078                     | 0380                                   | +43 76    | 2   | 45 2692           |                          |  |           |
| 1 $\frac{1}{2}$ | 53 4467           | 4467                     | 0444                                   | 50 75     |     |                   |                          |  |           |

Weighted mean..... +44 22  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... - 28  
 Radial velocity..... +25 9

1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

$\beta$  ORIONIS 1242 *c*.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7111           |                          |  |           | 2   | 53 0790           |                          |  |           |
| 1   | 54 0022           |                          |  |           | 2   | 45 2307           | 2655                     | 0268                                   | +27 97    |
| 3   | 53 9678           | 9990                     | 0292                                   | +33 61    | 2   | 45 2378           |                          |  |           |
| 2   | 53 4174           | 4500                     | 0477                                   | +54 55    |     |                   |                          |  |           |

Weighted mean..... +37 98  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... - 28  
 Radial velocity..... +19 7

1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 27<sup>m</sup>

♄ ORIONIS 1243 *a*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in p.v. <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev. <sup>ns</sup> | Velocity.           |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|---------------------|
| 2   | 54 7409           |                          |   |           | 2   | 53 1154           |                          |   |                     |
| 2   | 54 0332           |                          |   |           | 3   | 45 2837           | 2760                     | 0373                                    | -38 <sup>o</sup> 93 |
| 3   | 54 0104           | 0064                     | 0366                                    | -42 12    |     | 45 2814           |                          |   |                     |
| 2   | 53 4376           | 4346                     | 0323                                    | 36 94     |     |                   |                          |   |                     |

Weighted mean..... -39<sup>o</sup> 63  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... 28  
 Radial velocity..... -21 3

1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 27<sup>m</sup>

♄ ORIONIS 1243 *b*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev. <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev. <sup>ns</sup> | Velocity.           |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|---------------------|
| 2   | 54 7300           |                          |   |           | 2   | 53 1011           |                          |   |                     |
| 2   | 54 0188           |                          |   |           | 3   | 45 2702           | 2730                     | 0343                                    | +35 <sup>o</sup> 80 |
| 2   | 53 9988           | 0098                     | 0400                                    | -46 04    |     | 45 2712           |                          |   |                     |
| 2   | 53 4319           | 4429                     | 0406                                    | 46 43     |     |                   |                          |   |                     |

Weighted mean..... -41<sup>o</sup> 76  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... 28  
 Radial velocity..... -23 5

1908. Jan. 20.  
G. M. T. 15<sup>h</sup> 27<sup>m</sup>

♄ ORIONIS 1243 *c*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev. <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev. <sup>ns</sup> | Velocity.           |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|---------------------|
| 2   | 54 7244           |                          |   |           | 2   | 53 0980           |                          |   |                     |
| 2   | 54 0125           |                          |   |           | 3   | 45 2705           | 2820                     | 0433                                    | +45 <sup>o</sup> 19 |
| 2   | 53 9841           | 0000                     | 0302                                    | -34 76    |     | 45 2622           |                          |   |                     |
| 2   | 53 4295           | 4445                     | 0422                                    | 48 26     |     |                   |                          |   |                     |

Weighted mean..... -43<sup>o</sup> 09  
 $V_a$ ..... -17 93  
 $V_d$ ..... 09  
 Curvature..... 28  
 Radial velocity..... -24 8



SESSIONAL PAPER No. 25a

$\beta$  ORIONIS 1244 *a*

1908, Jan. 20,  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7275           | .....                    | .....                                  | .....     | 2   | 53 0998           | .....                    | .....                                  | .....     |
| 2   | 54 0201           | .....                    | .....                                  | .....     | 3   | 45 2686           | 2811                     | 0424                                   | 41 25     |
| 2   | 53 9936           | 0056                     | 0358                                   | 41 20     | 2   | 45 2611           | .....                    | .....                                  | .....     |
| 2   | 53 1305           | 4410                     | 0387                                   | 43 11     |     |                   |                          |  |           |

Weighted mean ..... 42 82  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... +24 5

$\beta$  ORIONIS 1244 *b*

1908, Jan. 20,  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7310           | .....                    | .....                                  | .....     | 2   | 53 1050           | .....                    | .....                                  | .....     |
| 2   | 54 0209           | .....                    | .....                                  | .....     | 3   | 45 2620           | 2723                     | 0336                                   | +35 07    |
| 3   | 53 9910           | 9990                     | 0292                                   | +33 61    | 2   | 45 2632           | .....                    | .....                                  | .....     |
| 2   | 53 1264           | 4340                     | 0317                                   | 36 25     |     |                   |                          |  |           |

Weighted mean ..... +34 82  
 $V_a$  ..... -17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... +16 5

$\beta$  ORIONIS 1244 *c*

1908, Jan. 20,  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7336           | .....                    | .....                                  | .....     | 2   | 53 1058           | .....                    | .....                                  | .....     |
| 2   | 54 0231           | .....                    | .....                                  | .....     | 3   | 45 2684           | 2780                     | 0393                                   | +41 02    |
| 3   | 54 0019           | 0090                     | 0392                                   | +45 11    | 2   | 45 2638           | .....                    | .....                                  | .....     |
| 2   | 53 4595           | 4460                     | 0437                                   | 49 97     |     |                   |                          |  |           |

Weighted mean ..... +44 75  
 $V_a$  ..... -17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... +26 4

$\beta$  ORIONIS 1245 *a.*

1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7272           |                          |  |           | 2   | 53 1018           |                          |  |           |
| 1   | 54 0156           |                          |  |           | 3   | 45 2650           | 2763                     | 0376                                   | +39 24    |
| 3   | 53 9966           | 0090                     | 0392                                   | +45 12    | 2   | 45 2622           |                          |  |           |
| 2   | 53 4315           | 4430                     | 0407                                   | 46 54     |     |                   |                          |  |           |

Weighted mean ..... +43 27  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... + 25.0

$\beta$  ORIONIS 1245 *b.*

1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7467           |                          |  |           | 2   | 53 1202           |                          |  |           |
| 2   | 54 0312           |                          |  |           | 3   | 45 2774           | 2750                     | 0363                                   | +37 89    |
| 3   | 54 0134           | 0074                     | 0376                                   | +43 27    | 2   | 45 2760           |                          |  |           |
| 2   | 53 4430           | 4340                     | 0337                                   | 38 53     |     |                   |                          |  |           |

Weighted mean ..... +40 07  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... + 21.8

$\beta$  ORIONIS 1245 *c.*

1908, Jan. 20.  
G. M. T. 15<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7458           |                          |  |           | 2   | 53 1193           |                          |  |           |
| 2   | 54 0321           |                          |  |           | 3   | 45 2750           | 2740                     | 0353                                   | +36 84    |
| 3   | 54 0084           | 0034                     | 0336                                   | +38 67    | 2   | 45 2742           |                          |  |           |
| 2   | 53 4436           | 4390                     | 0367                                   | 41 97     |     |                   |                          |  |           |

Weighted mean ..... +38 81  
 $V_a$  ..... -17 93  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... + 20.5

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$\beta$  ORIONIS 1249 a.

1908, Jan. 20.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7444           |                          |  |           | 2   | 53 1200           |                          |  |           |
| 2   | 54 0334           |                          |  |           | 3   | 45 2714           | 2663                     | 0291                                   | + 30 37   |
| 3   | 54 0037           | 9987                     | 0289                                   | + 33 26   | 2   | 45 2782           |                          |  |           |
| 2   | 53 4376           | 1320                     | 0297                                   | 33 96     |     |                   |                          |  |           |

Weighted mean ..... + 32 35  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... - 14 0

$\beta$  ORIONIS 1247 a.

1908, Jan. 20.  
G. M. T. 16<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7364           |                          |  |           | 2   | 53 1070           |                          |  |           |
| 1   | 54 0227           |                          |  |           | 2   | 45 2606           | 2745                     | 0327                                   | + 34 13   |
| 3   | 54 0078           | 0138                     | 0440                                   | + 50 64   | 2   | 45 2624           |                          |  |           |
| 2   | 53 4296           | 4350                     | 0327                                   | 37 40     |     |                   |                          |  |           |

Weighted mean ..... + 12 14  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... + 23 8

$\beta$  ORIONIS 1247 b.

1908, Jan. 20.  
G. M. T. 16<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7274           |                          |  |           | 2   | 53 0931           |                          |  |           |
| 1   | 54 0096           |                          |  |           | 3   | 45 2634           | 2794                     | 0397                                   | + 41 43   |
| 3   | 53 9963           | 0135                     | 0437                                   | + 50 29   | 2   | 45 2577           |                          |  |           |
| 2   | 53 4377           | 4557                     | 0534                                   | 61 06     |     |                   |                          |  |           |

Weighted mean ..... + 49 66  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... + 31 3

1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 17<sup>m</sup>

$\beta$  ORIONIS 1247c.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7281           |                          |  |           | 2   | 53 0985           |                          |  |           |
| 1   | 54 0124           |                          |  |           | 3   | 45 2528           | 2692                     | 0305                                     | +31 83    |
| 3   | 53 9902           | 0048                     | 0350                                     | +40 28    | 2   | 45 2570           |                          |  |           |
| 2   | 53 4238           | 4386                     | 0363                                     | 41 51     |     |                   |                          |  |           |

Weighted mean . . . . . - 37 42

$V_a$  . . . . . - 17 93

$V_d$  . . . . . - 09

Curvature . . . . . - 28

Radial velocity . . . . . + 19 0

$\beta$  ORIONIS 1248 a.

1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7173           |                          |  |           | 2   | 53 1167           |                          |  |           |
| 1   | 54 0314           |                          |  |           | 2   | 45 2794           |                          |  |           |
| 2   | 53 9942           | 9900                     | 0211                                     | +24 28    | 3   | 45 2792           | 2735                     | 0518                                     | +36 32    |
| 1   | 53 4267           | 4220                     | 0197                                     | 22 53     |     |                   |                          |  |           |

Weighted mean . . . . . - 30 01

$V_a$  . . . . . - 17 93

$V_d$  . . . . . - 09

Curvature . . . . . - 28

Radial velocity . . . . . - 11 6

$\beta$  ORIONIS 1248 b.

1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7402           |                          |  |           | 2   | 53 1140           |                          |  |           |
| 1   | 54 0234           |                          |  |           | 3   | 45 2824           | 2660                     | 0273                                     | +28 49    |
| 1   | 53 9742           | 9760                     | 0071                                     | + 8 17    | 2   | 45 2770           |                          |  |           |
| 1   | 53 4253           | 4260                     | 0237                                     | 27 10     |     |                   |                          |  |           |

Weighted mean . . . . . +24 15

$V_a$  . . . . . - 17 93

$V_d$  . . . . . - 09

Curvature . . . . . - 28

Radial velocity . . . . . + 5 8

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1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

$\beta$  ORIONIS 1248 *a*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7472           |                          |  |           | 2   | 53 1250           |                          |  |           |
| 1   | 54 0420           |                          |  |           | 3   | 45 2991           | 2891                     | 0504                                   | + 52 60   |
| 2   | 54 0294           | 0174                     | 0505                                   | 58 12     | 2   | 45 2836           |                          |  |           |
| 2   | 53 4593           | 4493                     | 0470                                   | 53 75     |     |                   |                          |  |           |

Weighted mean ..... + 54 51  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... + 36 1

1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

$\beta$  ORIONIS 1249 *b*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7478           |                          |  |           | 2   | 53 1232           |                          |  |           |
| 2   | 54 0356           |                          |  |           | 3   | 45 2788           | 2680                     | 0293                                   | + 30 58   |
| 2   | 54 0084           | 0004                     | 0306                                   | + 35 22   | —   | 45 2844           |                          |  |           |
| 2   | 53 4450           | 4365                     | 0342                                   | 39 11     |     |                   |                          |  |           |

Weighted mean ..... + 34 34  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... + 16 0

1908. Jan. 20.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

$\beta$  ORIONIS 1249 *c*.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7362           |                          |  |           | 2   | 53 1092           |                          |  |           |
| 2   | 54 0240           |                          |  |           | 3   | 45 2725           | 2760                     | 0373                                   | + 38 93   |
| 2   | 53 9998           | 0040                     | 0342                                   | + 39 36   | —   | 45 2704           |                          |  |           |
| 2   | 53 4435           | 4473                     | 0451                                   | 51 57     |     |                   |                          |  |           |

Weighted mean ..... + 42 66  
 $V_a$  ..... 17 93  
 $V_d$  ..... 09  
 Curvature ..... 28  
 Radial velocity ..... + 24 2

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 $\beta$  ORIONIS 1285*a*.1908, Jan. 27,  
G. M. T. 15<sup>h</sup> 30<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 56 2642           |                          |   |           | 2   | 54 8480           |                          |   |           |
| 2   | 56 2207           | 2768                     | 0470                                      | + 35 17   | 1½  | 42 3191           | 3130                     | 0520                                      | + 32 61   |
| 1½  | 55 3517           | 4083                     | 0539                                      | 39 88     | 2   | 42 3130           |                          |   |           |

Weighted mean..... +35 81  
 $V_a$ ..... - 20 08  
 $V_d$ ..... - 16  
 Curvature..... - 30

Radial velocity..... +15 3

 $\beta$  ORIONIS 1285*b*.1908, Jan. 27,  
G. M. T. 15<sup>h</sup> 30<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 57 3371           |                          |   |           | 2   | 54 8307           |                          |   |           |
| 2   | 56 2462           |                          |   |           | 2   | 42 3000           | 3283                     | 0673                                      | + 42 20   |
| 2   | 56 1983           | 2724                     | 0426                                      | - 31 88   | 1½  | 42 3092           |                          |   |           |
| 1   | 55 3500           | 4241                     | 0697                                      | 51 53     |     |                   |                          |   |           |

Weighted mean..... +39 72  
 $V_a$ ..... - 20 08  
 $V_d$ ..... - 16  
 Curvature..... - 30

Radial velocity..... +19 2

 $\beta$  ORIONIS 1285*c*.1908, Jan. 27,  
G. M. T. 15<sup>h</sup> 30<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 57 3127           |                          |   |           | 2   | 54 8130           |                          |   |           |
| 2   | 56 2255           |                          |   |           | 2   | 42 2834           |                          |   |           |
| 2   | 56 1773           | 2718                     | 0420                                      | + 31 43   | 1½  | 42 2936           | 3293                     | 0683                                      | + 42 83   |
| 2   | 55 3222           | 4147                     | 0603                                      | 44 62     |     |                   |                          |   |           |

Weighted mean..... +39 38  
 $V_a$ ..... - 20 08  
 $V_d$ ..... - 16  
 Curvature..... - 30

Radial velocity..... +17 9

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$\beta$  ORIONIS 1286 *a*.

1908. Jan. 27.  
G. M. T. 16<sup>h</sup> 09<sup>m</sup>.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57 2727           |                          |  |           | 2   | 54 7779           |                          |  |           |
| 2   | 56 1937           |                          |  |           | 2   | 42 2466           |                          |  |           |
| 2   | 56 1589           | 2869                     | 0571                                   | +42 73    | 1½  | 42 2512           | 3227                     | 0617                                   | +38 6     |
| 2   | 55 2850           | 4130                     | 0586                                   | 43 36     |     |                   |                          |  |           |

Weighted mean . . . . . - 42 20  
 $V_a$  . . . . . - 20 08  
 $V_d$  . . . . . - 19  
 Curvature . . . . . - 30

Radial velocity . . . . . - 21 3

$\beta$  ORIONIS 1286 *b*.

1908. Jan. 27.  
G. M. T. 16<sup>h</sup> 09<sup>m</sup>.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57 3533           |                          |  |           | 2   | 54 8539           |                          |  |           |
| 2   | 56 2652           |                          |  |           | 2   | 42 3240           |                          |  |           |
| 2   | 56 2297           | 2848                     | 0550                                   | +41 16    | 1½  | 42 3241           | 3192                     | 0582                                   | +36 50    |
| 1½  | 55 3552           | 4074                     | 0530                                   | 39 21     |     |                   |                          |  |           |

Weighted mean . . . . . +39 17  
 $V_a$  . . . . . - 20 08  
 $V_d$  . . . . . - 20  
 Curvature . . . . . - 28

Radial velocity . . . . . +18 7

$\beta$  ORIONIS 1286 *c*.

1908. Jan. 27.  
G. M. T. 16<sup>h</sup> 09<sup>m</sup>.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57 3761           |                          |  |           | 2   | 54 8777           |                          |  |           |
| 2   | 56 2915           |                          |  |           | 2   | 42 3443           |                          |  |           |
| 2   | 56 2610           | 2898                     | 0600                                   | +44 90    | 2   | 42 3548           | 3296                     | 0686                                   | +43 02    |
| 2   | 55 3896           | 4175                     | 0631                                   | 46 68     |     |                   |                          |  |           |

Weighted mean . . . . . +44 87  
 $V_a$  . . . . . - 20 08  
 $V_d$  . . . . . - 19  
 Curvature . . . . . - 30

Radial velocity . . . . . +24 3

1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 17<sup>m</sup> $\beta$  ORIONIS 1289 *a.*Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57.3477           |                          |  |           | 2   | 54.8500           |                          |  |           |
| 2   | 56.2633           |                          |  |           | 3   | 42.3258           | 3168                     | 0558                                     | +34.99    |
| 2   | 56.2241           | 1671                     | 0627                                     | +46.92    | 2   | 42.3286           |                          |  |           |
| 1½  | 55.3680           | 3070                     | 0474                                     | 35.07     |     |                   |                          |  |           |

Weighted mean ..... +38.62  
 $V_a$  ..... -20.08  
 $V_d$  ..... .19  
 Curvature ..... .30

Radial velocity ..... +18.1

1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 17<sup>m</sup> $\beta$  ORIONIS 1289 *b.*Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57.3801           |                          |  |           | 2   | 54.8794           |                          |  |           |
| 1   | 56.2921           |                          |  |           | 3   | 42.3664           | 3275                     | 0665                                     | +41.70    |
| 3   | 56.2507           | 2780                     | 0482                                     | +36.07    | 2   | 42.3584           |                          |  |           |
| 2   | 55.3890           | 4155                     | 0611                                     | 45.21     |     |                   |                          |  |           |

Weighted mean ..... +40.46  
 $V_a$  ..... -20.08  
 $V_d$  ..... .19  
 Curvature ..... .30

Radial velocity ..... +19.9

1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 17<sup>m</sup> $\beta$  ORIONIS 1289 *c.*Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57.3608           |                          |  |           | 2   | 54.8612           |                          |  |           |
| 2   | 56.2675           |                          |  |           | 3   | 42.3602           | 3425                     | 0815                                     | +51.11    |
| 3   | 56.2378           | 2900                     | 0602                                     | +45.05    | 2   | 42.3378           |                          |  |           |
| 2   | 55.3721           | 4200                     | 0656                                     | 48.54     |     |                   |                          |  |           |

Weighted mean ..... +48.19  
 $V_a$  ..... -20.08  
 $V_d$  ..... .19  
 Curvature ..... .30

Radial velocity ..... +27.8



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1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 28<sup>m</sup>

$\beta$  ORIONIS 1290 *a.*

Observed by J. S. PLASKETT  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57 3519           |                          |  |           | 2   | 54 8582           |                          |  |           |
| 2   | 56 2658           |                          |  |           | 2   | 42 3268           | 3156                     | 0546                                   | + 34 24   |
| 3   | 56 2260           | 2800                     | 0502                                   | + 37 56   | 2   | 42 3368           |                          |  |           |

Weighted mean ..... + 36 23  
 $V_a$  ..... - 20 08  
 $V_d$  ..... 19  
 Curvature ..... 30  
 Radial velocity ..... + 15 6

1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 28<sup>m</sup>

$\beta$  ORIONIS 1290 *b.*

Observed by J. S. PLASKETT  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 57 3527           |                          |  |           | 2   | 54 8536           |                          |  |           |
| 2   | 56 2622           |                          |  |           | 2   | 42 3223           | 3190                     | 0580                                   | + 36 37   |
| 3   | 56 2360           | 2940                     | 0642                                   | + 48 04   | 2   | 42 3224           |                          |  |           |
| 2   | 55 3534           | 4074                     | 0530                                   | + 39 21   |     |                   |                          |  |           |

Weighted mean ..... - 42 18  
 $V_a$  ..... - 20 08  
 $V_d$  ..... 19  
 Curvature ..... 30  
 Radial velocity ..... - 21 6

1908. Jan. 27.  
G. M. T. 17<sup>h</sup> 28<sup>m</sup>

$\beta$  ORIONIS 1290 *c.*

Observed by J. S. PLASKETT  
Measured by

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 57 3596           |                          |  |           | 2   | 54 8680           |                          |  |           |
| 2               | 56 2706           |                          |  |           | 3   | 42 3490           | 3313                     | 0503                                   | + 31 54   |
| 3               | 56 2320           | 2810                     | 0612                                   | + 38 31   | 2   | 42 3368           |                          |  |           |
| 1 $\frac{1}{2}$ | 55 3704           | 4134                     | 0590                                   | + 43 65   |     |                   |                          |  |           |

Weighted mean ..... + 36 70  
 $V_a$  ..... - 20 08  
 $V_d$  ..... 19  
 Curvature ..... 30  
 Radial velocity ..... - 16 1

1908. Mar. 20.  
G. M. T. 11<sup>h</sup> 51<sup>m</sup>

3 ORIONIS 1405.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3300           |                          |   |           | 2   | 58 7869           |                          |   |           |
| 2   | 61 3502           |                          |   |           | 2   | 36 2090           | 2170                     | 1265                                    | +44.48    |
| 2   | 61 3121           | 3064                     | 1259                                    | -52.05    | 2   | 36 1858           |                          |   |           |
| 1½  | 59 7292           | 7236                     | 1271                                    | 52.00     |     |                   |                          |   |           |

Weighted mean ..... -48.37  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28  
 Radial velocity ..... +23.1

1908. Mar. 20.  
G. M. T. 12<sup>h</sup> 07<sup>m</sup>

3 ORIONIS 1406.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3238           |                          |   |           | 2   | 58 7846           |                          |   |           |
| 2   | 61 3466           |                          |   |           | 1½  | 36 2180           | 2235                     | 1330                                    | +46.76    |
| 2   | 61 3115           | 3065                     | 1290                                    | -56.33    | 2   | 36 1886           |                          |   |           |
| 1½  | 59 7150           | 7122                     | 1157                                    | 47.33     |     |                   |                          |   |           |

Weighted mean ..... +49.56  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28  
 Radial velocity ..... +24.3

1908. Mar. 20.  
G. M. T. 12<sup>h</sup> 21<sup>m</sup>

3 ORIONIS 1407.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3248           |                          |   |           | 2   | 58 7785           |                          |   |           |
| 2   | 61 3441           |                          |   |           | 2   | 36 1872           | 2090                     | 1185                                    | +41.66    |
| 3   | 61 2936           | 2941                     | 1136                                    | +46.96    | 2   | 36 1721           |                          |   |           |
| 1½  | 59 7240           | 7260                     | 1295                                    | 52.98     |     |                   |                          |   |           |

Weighted mean ..... +46.72  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28  
 Radial velocity ..... +21.4

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1908. Mar. 20.  
G. M. T. 12<sup>h</sup> 32<sup>m</sup>

$\beta$  ORIONIS 1408.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3338           |                          |  |           | 2   | 58 7904           |                          |  |           |
| 2   | 61 3533           |                          |  |           | 2   | 36 2218           | 2315                     | 1410                                   | +49.58    |
| 2   | 61 3036           | 2946                     | 1141                                   | -47.17    | 1½  | 36 1832           |                          |  |           |
| 1½  | 59 7392           | 7302                     | 1337                                   | 54.70     |     |                   |                          |  |           |

Weighted mean ..... 59.15  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28

Radial velocity ..... +24.9

1908. Mar. 20.  
G. M. T. 12<sup>h</sup> 46<sup>m</sup>

$\beta$  ORIONIS 1409.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3224           |                          |  |           | 1   | 58 7782           |                          |  |           |
| 2   | 61 3452           |                          |  |           | 2   | 36 2226           | 2365                     | 1400                                   | +51.33    |
| 2   | 61 3028           | 3048                     | 1243                                   | +51.39    | 2   | 36 1801           |                          |  |           |
| 1½  | 59 7364           | 7390                     | 1425                                   | 58.30     |     |                   |                          |  |           |

Weighted mean ..... +53.25  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28

Radial velocity ..... +28.0

1908. Mar. 20.  
G. M. T. 13<sup>h</sup> 00<sup>m</sup>

$\beta$  ORIONIS 1410.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3280           |                          |  |           | 2   | 58 7856           |                          |  |           |
| 2   | 61 3492           |                          |  |           | 2   | 36 2229           | 2265                     | 1360                                   | +47.82    |
| 2   | 61 3050           | 3010                     | 1205                                   | +49.81    | 2   | 36 1906           |                          |  |           |
| 1½  | 59 7178           | 7136                     | 1171                                   | 47.91     |     |                   |                          |  |           |

Weighted mean ..... +48.57  
 $V_a$  ..... -24.86  
 $V_d$  ..... -14  
 Curvature ..... -28

Radial velocity ..... -23.3

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1908. March 20.  
G. M. T. 13<sup>h</sup> 12<sup>m</sup> $\beta$  ORIONIS 1411.Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 1088           | .....                    | .....                                  | .....    | 2   | 58 5647           | .....                    | .....                                  | .....     |
| 3   | 61 0842           | 61 2989                  | - 1184                                 | +48 95   | 2   | 35 9500           | .....                    | .....                                  | .....     |
| 1½  | 59 5695           | 59 7259                  | -1294                                  | 52 94    | 2   | 6 9 51            | 36 2203                  | -1298                                  | -45 64    |

Weighted mean..... +48 85

 $V_a$ ..... -24 86 $V_d$ ..... - 17

Curvature..... - 28

Radial velocity..... -23 5

1908. March 20.  
G. M. T. 13<sup>h</sup> 27<sup>m</sup> $\beta$  ORIONIS 1412.Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 1178           | .....                    | .....                                  | .....     | 2   | 58 5736           | .....                    | .....                                  | .....     |
| 3   | 61 0974           | 61 3005                  | -1260                                  | -49 60    | 2   | 35 9727           | .....                    | .....                                  | .....     |
| 2   | 59 5242           | 59 7314                  | -1349                                  | 55 18     | 2   | 36 0000           | 36 2215                  | -1310                                  | -46 06    |

Weighted mean..... +50 18

 $V_a$ ..... -24 86 $V_d$ ..... - 17

Curvature..... -28

Radial velocity..... +24 9

1908. March 20.  
G. M. T. 13<sup>h</sup> 47<sup>m</sup> $\beta$  ORIONIS 1413.Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in Rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3873           | .....                    | .....                                  | .....     | 2   | 58 8412           | .....                    | .....                                  | .....     |
| 3   | 61 3699           | 61 3083                  | -1278                                  | +52 83    | 2   | 36 3010           | 36 2455                  | -1550                                  | -54 50    |
| 1½  | 59 7810           | 59 7205                  | -1240                                  | 50 73     | 2   | 36 2495           | .....                    | .....                                  | .....     |

Weighted mean..... +52 86

 $V_a$ ..... -24 86 $V_d$ ..... - 17

Curvature..... -28

Radial velocity..... +27 5

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$\delta$  ORIONIS 1411.

1908. March 20.  
G. M. T. 13<sup>h</sup> 57<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3927           |                          |  |           | 2   | 58 8485           |                          |  |           |
| 3   | 61 3695           | 61 3915                  | 1210                                   | 50 02     | 2   | 36 2981           | 36 2350                  | 1445                                   | +54 40    |
| 2   | 59 7945           | 59 7270                  | 1370                                   | 53 38     | 2   | 36 2572           |                          |  |           |

Weighted mean . . . . . +52 23  
 $V_a$  . . . . . 24 86  
 $V_d$  . . . . . 17  
 Curvature . . . . . 28  
 Radial velocity . . . . . +26 9

$\delta$  ORIONIS 1426.

1908. March 24.  
G. M. T. 12<sup>h</sup> 03<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| 2               | 63 3455           |                          |  |           | 2               | 58 7935           |                          |  |           |
| 2               | 61 2946           | 61 2780                  | 9975                                   | +40 35    | 1 $\frac{1}{2}$ | 36 1955           | 36 2300                  | 1395                                   | +49 05    |
| 1 $\frac{1}{2}$ | 59 7192           | 59 7040                  | 1075                                   | 43 98     | 2               | 36 1592           |                          |  |           |

Weighted mean . . . . . +44 05  
 $V_a$  . . . . . 24 36  
 $V_d$  . . . . . 16  
 Curvature . . . . . 28  
 Radial velocity . . . . . +19 2

$\beta$  ORIONIS 1427.

1908. March 24.  
G. M. T. 12<sup>h</sup> 15<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3382           |                          |  |           | 2   | 58 7912           |                          |  |           |
| 2   | 61 2918           | 61 2798                  | 9933                                   | +41 09    | 2   | 36 2085           | 36 2340                  | 1435                                   | +50 45    |
| 1   | 59 7208           | 59 7098                  | 1133                                   | 46 35     | 2   | 36 1682           |                          |  |           |

Weighted mean . . . . . +45 89  
 $V_a$  . . . . . 24 36  
 $V_d$  . . . . . 16  
 Curvature . . . . . 28  
 Radial velocity . . . . . +21 1

$\beta$  ORIONIS 1428.

1908. March 24.  
G. M. T. 12<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63·3148           |                          |                            |           | 2   | 58·7726           |                          |                            |           |
| 2   | 61·2682           | 61·2772                  | ·0967                      | -40·01    | 2   | 36·1838           | 36·2255                  | ·1350                      | +47·47    |
| 1½  | 59·6971           | 59·7060                  | ·1095                      | 44·86     | 2   | 36·1522           |                          |                            |           |

Weighted mean..... +44·03  
 $V_a$ ..... -24·36  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... +19·2

$\beta$  ORIONIS 1429.

1908. March 24.  
G. M. T. 12<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63·3133           |                          |                            |           | 2   | 58·7619           |                          |                            |           |
| 2   | 61·2675           | 61·2825                  | ·1020                      | -42·21    | 2   | 36·1559           | 36·2215                  | ·1310                      | +46·06    |
| 1½  | 59·6988           | 59·7160                  | ·1195                      | 48·89     | 2   | 36·1282           |                          |                            |           |

Weighted mean..... +45·43  
 $V_a$ ..... -24·36  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... +21·6

$\beta$  ORIONIS 1430.

1908. March 24.  
G. M. T. 12<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63·3288           |                          |                            |           | 2   | 58·7792           |                          |                            |           |
| 2   | 61·2808           | 61·2795                  | ·0995                      | +41·17    | 1½  | 36·1830           | 36·2190                  | ·1285                      | +45·18    |
| 1½  | 59·7068           | 59·7075                  | ·1110                      | 45·41     | 2   | 36·1581           |                          |                            |           |

Weighted mean..... +43·65  
 $V_a$ ..... -24·36  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... +18·8

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$\gamma$  ORIONIS 1431.

1908. March 24.  
G. M. T. 12<sup>h</sup> 52<sup>m</sup>

Observed by J. S. PLASKETT  
Measured by J. S. PLASKETT

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3248           | .....                    | .....                                  | .....     | 2   | 58 7802           | .....                    | .....                                  | .....     |
| 2   | 61 2775           | 61 2775                  | 0970                                   | +40 14    | 2   | 36 1932           | 36 2350                  | 1445                                   | +50 81    |
| 1½  | 59 6884           | 59 6890                  | 0925                                   | +37 84    | 2   | 36 1520           | .....                    | .....                                  | .....     |

Weighted mean ..... +43 39  
 $V_a$  ..... 24 36  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... +18 6

$\gamma$  ORIONIS 1433.

1908. March 24.  
G. M. T. 13<sup>h</sup> 16<sup>m</sup>

Observed by J. S. PLASKETT  
Measured by J. S. PLASKETT

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3394           | .....                    | .....                                  | .....     | 2   | 58 7740           | .....                    | .....                                  | .....     |
| 2   | 61 2791           | 61 2816                  | 1011                                   | +41 84    | 2   | 36 1666           | 36 2106                  | 1201                                   | +42 23    |
| 1½  | 59 6956           | 59 7020                  | 0955                                   | 43 16     | 2   | 36 1490           | .....                    | .....                                  | .....     |

Weighted mean ..... + 42 34  
 $V_a$  ..... 24 36  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... + 17 5

$\gamma$  ORIONIS 1434.

1908. March 24.  
G. M. T. 13<sup>h</sup> 32<sup>m</sup>

Observed by J. S. PLASKETT  
Measured by J. S. PLASKETT

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3430           | .....                    | .....                                  | .....     | 2   | 58 7969           | .....                    | .....                                  | .....     |
| 2   | 61 2968           | 61 2790                  | 0985                                   | +40 76    | 1   | 36 2018           | 36 2210                  | 1305                                   | +45 88    |
| 1   | 59 7385           | 59 7215                  | 1254                                   | 51 30     | 2   | 36 1742           | .....                    | .....                                  | .....     |

Weighted mean ..... + 44 08  
 $V_a$  ..... 24 36  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... + 19 3

1908. March 24.  
G. M. T. 13<sup>h</sup> 39<sup>m</sup>

♂ ORIONIS 1435.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 3082          |                          |   |           | 2   | 58° 7515          |                          |   |           |
| 2   | 61° 2508          | 61° 2727                 | 0922                                    | - 38° 15  | 1½  | 36° 1366          | 36° 2126                 | 1221                                    | - 42° 93  |
| 1   | 59° 6764          | 59° 7034                 | 1069                                    | 43° 32    | 2   | 36° 1180          |                          |   |           |

Weighted mean ..... - 40° 89  
 $V_a$  ..... - 24° 36  
 $V_d$  ..... 16  
 Curvature ..... - 28  
 Radial velocity ..... - 16.1

1908. March 24.  
G. M. T. 13<sup>h</sup> 48<sup>m</sup>

♂ ORIONIS 1436.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 3496          |                          |   |           | 2   | 58° 8030          |                          |   |           |
| 1½  | 61° 2902          | 61° 2762                 | 0957                                    | - 39° 60  | 1½  | 36° 2066          | 36° 2310                 | 1905                                    | + 49° 40  |
| 1   | 59° 7106          | 59° 6876                 | 0921                                    | 37° 68    | 2   | 36° 1692          |                          |   |           |

Weighted mean ..... - 41° 96  
 $V_a$  ..... - 24° 36  
 $V_d$  ..... 16  
 Curvature ..... - 28  
 Radial velocity ..... - 17.2

1908. March 24  
G. M. T. 13<sup>h</sup> 56<sup>m</sup>

♂ ORIONIS 1437.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 3020          |                          |   |           | 2   | 58° 7548          |                          |   |           |
| 1½  | 61° 2558          | 61° 2800                 | 0995                                    | - 41° 17  | 2   | 36° 1466          | 36° 2180                 | 1275                                    | + 44° 83  |
| 1   | 59° 6798          | 59° 7050                 | 1085                                    | 44° 39    | 2   | 36° 1222          |                          |   |           |

Weighted mean ..... + 43° 51  
 $V_a$  ..... - 24° 36  
 $V_d$  ..... 16  
 Curvature ..... - 28  
 Radial velocity ..... - 18.7



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1908, March 24,  
G. M. T. 1<sup>h</sup> 07<sup>m</sup>

$\beta$  ORIONIS 1438.

Observed by J. S. PLASKETT,  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3504           |                          |  |           | 2   | 58.8022           |                          |  |           |
| 1½  | 61.3018           | 61.2780                  | 0975                                   | +40.54    | 1½  | 36.2016           | 36.2170                  | 1265                                   | +44.48    |
| 1   | 59.7345           | 59.7125                  | 1160                                   | 47.46     | 2   | 36.1784           |                          |  |           |

Weighted mean ..... +43.75  
 $V_a$  ..... 21.36  
 $V_d$  ..... 16  
 Curvature..... 28  
 Radial velocity ..... +18.0

1908, March 30,  
G. M. T. 12<sup>h</sup> 29<sup>m</sup>

$\beta$  ORIONIS 1439.

Observed by J. S. PLASKETT,  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3002           |                          |  |           | 2   | 58.7534           |                          |  |           |
| 3   | 61.2444           | 61.2993                  | 0870                                   | +35.86    | 2   | 36.1192           | 36.1568                  | 1087                                   | +38.11    |
| 1½  | 59.6804           | 59.7304                  | 1066                                   | 43.48     | 2   | 36.1146           |                          |  |           |

Weighted mean ..... +38.31  
 $V_a$  ..... 23.39  
 $V_d$  ..... 21  
 Curvature..... 28  
 Radial velocity ..... +14.4

1908, March 30,  
G. M. T. 12<sup>h</sup> 29<sup>m</sup>

$\beta$  ORIONIS 1440.

Observed by J. S. PLASKETT,  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3356           |                          |  |           | 2   | 58.7895           |                          |  |           |
| 3   | 61.2894           | 61.3087                  | 0964                                   | +39.74    | 2   | 36.1602           | 36.1480                  | 0999                                   | +35.02    |
| 1½  | 59.6994           | 59.7132                  | 0894                                   | 40.54     | 2   | 36.1642           |                          |  |           |

Weighted mean ..... +38.24  
 $V_a$  ..... 23.39  
 $V_d$  ..... 21  
 Curvature..... 28  
 Radial velocity ..... +14.4

3 ORIONIS 1441.

1908. Mar. 30.  
G. M. T. 12<sup>h</sup> 38<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 4150           |                          |  |           | 2   | 58 8640           |                          |  |           |
| 2   | 61 3622           | 3042                     | 0919                                   | -37 88    | 1½  | 36 2522           | 1620                     | 1139                                   | -39 93    |
| 1   | 59 7768           | 7148                     | 0910                                   | 37 12     | 2   | 36 2426           |                          |  |           |

Weighted mean ..... +38 39  
 $V_a$  ..... -23 39  
 $V_d$  ..... -21  
 Curvature..... -28  
 Radial velocity..... -14 5

3 ORIONIS 1442.

1908. Mar. 30.  
G. M. T. 12<sup>h</sup> 49<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3596           |                          |  |           | 2   | 58 8129           |                          |  |           |
| 2   | 61 3220           | 3175                     | 1052                                   | -43 36    | 1½  | 36 1715           | 1572                     | 1091                                   | +38 25    |
| 1½  | 59 7322           | 7220                     | 0982                                   | 40 06     | 2   | 36 1666           |                          |  |           |

Weighted mean..... +40 84  
 $V_a$  ..... -23 39  
 $V_d$  ..... -21  
 Curvature..... -28  
 Radial velocity..... -17 0

3 ORIONIS 1448.

1908. April 3.  
G. M. T. 12<sup>h</sup> 16<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3573           |                          |  |           | 2   | 58 8206           |                          |  |           |
| 2½  | 61 3387           | 61 3037                  | 1232                                   | +50 93    | 1½  | 36 2340           | 36 2126                  | 1184                                   | +41 63    |
| 1½  | 59 7341           | 59 7160                  | 1195                                   | 48 89     | 2   | 36 2156           |                          |  |           |

Weighted mean..... +48 02  
 $V_a$  ..... -22 69  
 $V_d$  ..... -16  
 Curvature..... -28  
 Radial velocity..... +24 9

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$\beta$  ORIONIS 1419.

1908. April 3.  
G. M. T. 12<sup>h</sup> 28<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3266           |                          |  |           | 2   | 58.7829           |                          |  |           |
| 2   | 61.3045           | 61.3024                  | 1219                                   | +50.59    | 2   | 36.2068           | 36.2285                  | 1380                                   | +48.52    |
| 1½  | 59.7388           | 59.7320                  | 1355                                   | 55.43     | 2   | 36.1722           |                          |  |           |

Weighted mean ..... +51.08  
 $V_a$  ..... -22.69  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +27.9

$\beta$  ORIONIS 1450.

1908. April 3.  
G. M. T. 12<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3216           |                          |  |           | 2   | 58.7768           |                          |  |           |
| 2   | 61.3092           | 61.3124                  | 1319                                   | +54.53    | 1   | 36.2098           | 36.2325                  | 1420                                   | +49.93    |
| 1½  | 59.7388           | 59.7428                  | 1463                                   | 59.85     | 2   | 36.1714           |                          |  |           |

Weighted mean ..... +55.28  
 $V_a$  ..... -22.69  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +32.2

$\beta$  ORIONIS 1451.

1908. April 3.  
G. M. T. 12<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3301           |                          |  |           | 2   | 58.7860           |                          |  |           |
| 2   | 61.3062           | 61.3007                  | 1202                                   | +49.69    | 1½  | 36.2164           | 36.2275                  | 1370                                   | +48.47    |
| 1½  | 59.7310           | 59.7260                  | 1295                                   | 52.98     | 2   | 36.1830           |                          |  |           |

Weighted mean ..... +50.22  
 $V_a$  ..... -22.69  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +27.1

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1908, April 4.  
G. M. T. 12<sup>h</sup> 19<sup>m</sup> $\beta$  ORIONIS 1457.Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3698           |                          |  |           | 2   | 58.8305           |                          |  |           |
| 3   | 61.3515           | 61.3069                  | 1264                                     | +52.25    | 2   | 36.2996           | 36.2580                  | 1638                                     | +57.59    |
| 2   | 59.7708           | 59.7224                  | 1259                                     | 51.51     | 2   | 36.2358           |                          |  |           |

Weighted mean ..... +53.56  
 $V_a$  ..... 22.41  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... +29.9

1908, April 4.  
G. M. T. 12<sup>h</sup> 28<sup>m</sup> $\beta$  ORIONIS 1458.Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3566           |                          |  |           | 2   | 58.8112           |                          |  |           |
| 2   | 61.3314           | 61.3004                  | 1199                                     | +49.57    | 1½  | 36.2475           | 36.2460                  | 1551                                     | +54.67    |
| 1½  | 59.7500           | 59.7196                  | 1231                                     | 50.36     | 2   | 36.1956           |                          |  |           |

Weighted mean ..... +51.34  
 $V_a$  ..... 22.40  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... -27.4

1908, April 4.  
G. M. T. 12<sup>h</sup> 38<sup>m</sup> $\beta$  ORIONIS 1459.Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3648           |                          |  |           | 2   | 58.8227           |                          |  |           |
| 3   | 61.3354           | 61.2944                  | 1139                                     | +47.09    | 1½  | 36.2782           | 36.2500                  | 1625                                     | +57.13    |
| 1½  | 59.7562           | 59.7150                  | 1185                                     | 48.47     | 2   | 36.2194           |                          |  |           |

Weighted mean ..... +49.93  
 $V_a$  ..... 22.40  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... +27.0

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$\delta$  ORIONIS 1469.

1908. April 13.  
G. M. T. 12<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-------|-------------------|--------------------------|--|-----------|
| .....           | 63 3830           | .....                    | .....                                  | .....     | ..... | 58 8337           | .....                    | .....                                  | .....     |
| .....           | 61 4037           | .....                    | .....                                  | .....     | ..... | 36 1867           | .....                    | .....                                  | .....     |
| 2 $\frac{1}{2}$ | 61 3453           | 3210                     | 1087                                   | +44 81    | 1     | 36 2037           | 1690                     | 1209                                   | +42 38    |
| 1 $\frac{1}{2}$ | 59 7340           | 7090                     | 1852                                   | 34 75     | ..... | .....             | .....                    | .....                                  | .....     |

Weighted mean ..... +42 03  
 $V_a$  ..... -20 23  
 $V_d$  ..... - 28  
 Curvature ..... - 28  
 Radial velocity ..... +21 3

$\beta$  ORIONIS 1470.

1908. April 13.  
G. M. T. 12<sup>h</sup> 22<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-------|-------------------|--------------------------|--|-----------|-------|-------------------|--------------------------|--|-----------|
| ..... | 63 3425           | .....                    | .....                                  | .....     | ..... | 58 7861           | .....                    | .....                                  | .....     |
| ..... | 61 3570           | .....                    | .....                                  | .....     | ..... | 36 1305           | .....                    | .....                                  | .....     |
| ..... | 61 3030           | 3230                     | 1107                                   | +45 63    | ..... | 36 1485           | 1700                     | 1219                                   | -42 73    |
| ..... | 59 7213           | 7419                     | 1202                                   | 49 03     | ..... | .....             | .....                    | .....                                  | .....     |

Weighted mean ..... +45 75  
 $V_a$  ..... -20 23  
 $V_d$  ..... - 25  
 Curvature ..... - 28  
 Radial velocity ..... +25 0

$\beta$  ORIONIS 1471.

1908. April 13.  
G. M. T. 12<sup>h</sup> 34<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| .....           | 63 3504           | .....                    | .....                                  | .....     | .....           | 58 7960           | .....                    | .....                                  | .....     |
| .....           | 61 3650           | .....                    | .....                                  | .....     | .....           | 36 1787           | .....                    | .....                                  | .....     |
| 2 $\frac{1}{2}$ | 61 3036           | 3156                     | 1033                                   | +42 58    | 1 $\frac{1}{2}$ | 36 1611           | 1876                     | 1395                                   | +48 89    |
| 1 $\frac{1}{2}$ | 59 7275           | 7400                     | 1162                                   | 47 40     | .....           | .....             | .....                    | .....                                  | .....     |

Weighted mean ..... +45 61  
 $V_a$  ..... -20 23  
 $V_d$  ..... - 26  
 Curvature ..... - 28  
 Radial velocity ..... +24 8

$\beta$  ORIONIS 1873.

1908. Sept. 7.  
G. M. T. 21<sup>h</sup> 52<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3948           |                          |  |           | 2   | 58.8286           |                          |  |           |
| 2   | 61.4080           |                          |  |           | 2   | 36.1061           |                          |  |           |
| 2   | 61.2458           | 2498                     | 0068                                   | +2.18     | 1   | 35.9859           | 9890                     | 0168                                   | -5.87     |
| 2   | 59.6682           | 6722                     | 0208                                   | +8.46     |     |                   |                          |  |           |

Weighted mean ..... + 3.08  
 $V_a$  ..... + 25.29  
 $V_d$  ..... + .09  
 Curvature ..... - .28  
 Radial velocity ..... + 28.2

$\beta$  ORIONIS 1874.

1908. Sept. 7.  
G. M. T. 22<sup>h</sup> 10<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3952           |                          |  |           | 2   | 58.8342           |                          |  |           |
| 2   | 61.4064           |                          |  |           | 2   | 36.1037           |                          |  |           |
| 2   | 61.2468           | 2495                     | 0050                                   | +2.06     | 1   | 35.9972           | 9025                     | 0033                                   | -1.15     |
| 2   | 59.6584           | 6600                     | 0086                                   | +3.50     |     |                   |                          |  |           |

Weighted mean ..... + 1.99  
 $V_a$  ..... + 25.29  
 $V_d$  ..... + .09  
 Curvature ..... - .28  
 Radial velocity ..... + 27.1

$\beta$  ORIONIS 1935.

1908. Oct. 13.  
G. M. T. 21<sup>h</sup> 19<sup>m</sup>

Observed by } J. S. PLASKETT.  
 Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3985           |                          |  |           | 2   | 58.8313           |                          |  |           |
| 2   | 61.4043           |                          |  |           | 2   | 36.1175           |                          |  |           |
| 2   | 61.2224           | 2270                     | 0175                                   | -7.19     | 1   | 36.0062           | 9982                     | 0076                                   | -2.66     |
| 1   | 59.6723           | 6760                     | 0210                                   | +8.54     |     |                   |                          |  |           |

Weighted mean ..... - 2.00  
 $V_a$  ..... + 20.66  
 $V_d$  ..... - .05  
 Curvature ..... - .28  
 Radial velocity ..... + 18.3

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$\beta$  ORIONIS 1936.

1908, Oct. 13,  
G. M. T. 21<sup>h</sup> 48<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 63 3626           |                          |  |           | 2   | 58 7965           |                          |  |           |
| 2               | 61 3762           |                          |  |           | 2   | 36 0878           |                          |  |           |
| 3               | 61 1940           | 2285                     | 0150                                     | 6 58      | 1   | 35 9778           | 0000                     | 0058                                     | -2 03     |
| 1 $\frac{1}{2}$ | 59 6216           | 6576                     | 0062                                     | 2 52      |     |                   |                          |  |           |

Weighted mean ..... 3 27  
 $V_a$  ..... -20 66  
 $V_d$  ..... 10  
 Curvature ..... 28

Radial velocity ..... +17 0

$\beta$  ORIONIS 1937.

1908, Oct. 13,  
G. M. T. 22<sup>h</sup> 19<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| 2   | 63 3670           |                          |  |           | 2               | 58 8030           |                          |  |           |
| 2   | 61 3727           |                          |  |           | 2               | 36 0830           |                          |  |           |
| 2   | 61 2061           | 2411                     | 0031                                     | 1 27      | 1 $\frac{1}{2}$ | 36 9604           | 9875                     | 0183                                     | -6 50     |
| 1   | 59 6093           | 6123                     | 0031                                     | 3 70      |                 |                   |                          |  |           |

Weighted mean ..... 2 71  
 $V_a$  ..... -20 65  
 $V_d$  ..... 14  
 Curvature ..... 28

Radial velocity ..... -17 5

$\beta$  ORIONIS 1938.

1908, Oct. 13,  
G. M. T. 22<sup>h</sup> 47<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3806           |                          |  |           | 2   | 58 8156           |                          |  |           |
| 2   | 61 3922           |                          |  |           | 2   | 36 1048           |                          |  |           |
| 3   | 61 2124           | 2 04                     | 0111                                     | - 5 80    | 1   | 35 9790           | 9840                     | 0218                                     | - 7 62    |
| 2   | 59 6301           | 6386                     | 0128                                     | 5 20      |     |                   |                          |  |           |

Weighted mean ..... 5 90  
 $V_a$  ..... -20 65  
 $V_d$  ..... 18  
 Curvature ..... 28

Radial velocity ..... -14 3

$\beta$  ORIONIS 1978.1908. Nov. 21.  
G. M. T. 18<sup>h</sup> 21<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3468           |                          |  |          | 2   | 58.7938           |                          |  |           |
| 2   | 61.3628           |                          |  |          | 2   | 36.1436           |                          |  |           |
| 1   | 61.2132           | 2282                     | 0159                                   | + 6.55   | 1/2 | 36.0681           | 0766                     | 0285                                   | + 9.99    |
| 1/2 | 59.6547           | 6700                     | 0462                                   | 18.75    |     |                   |                          |  |           |

Weighted mean ..... +10.46  
 $V_a$  ..... + 6.82  
 $V_d$  ..... - .02  
 Curvature ..... - .28

Radial velocity ..... +17.0

 $\beta$  ORIONIS 1979.1908. Nov. 21.  
G. M. T. 18<sup>h</sup> 43<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2     | 63.3061           |                          |  |           | 2   | 58.7652           |                          |  |           |
| 2     | 61.3300           |                          |  |           | 2   | 36.1120           |                          |  |           |
| 1 1/2 | 61.1662           | 2174                     |  |           | 1/2 | 36.0187           | 0587                     | 0106                                   | + 3.72    |
| 1     | 59.6741           | 6591                     | 0853                                   | +14.39    |     |                   |                          |  |           |

Weighted mean ..... +10.83  
 $V_a$  ..... + 6.82  
 $V_d$  ..... - .05  
 Curvature ..... - .28

Radial velocity ..... +17.3

 $\beta$  ORIONIS 1980.1908. Nov. 21.  
G. M. T. 19<sup>h</sup> 05<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-------|-------------------|--------------------------|--|-----------|
| 2   | 63.3533           |                          |  |           | 2     | 58.7995           |                          |  |           |
| 2   | 61.3671           |                          |  |           | 2     | 36.1350           |                          |  |           |
| 3   | 61.2382           | 2480                     | 0357                                   | +14.72    | 1 1/2 | 36.0917           | 1090                     | 0609                                   | +21.34    |
| 2   | 59.6646           | 6745                     | 0507                                   | 20.58     |       |                   |                          |  |           |

Weighted mean ..... +18.08  
 $V_a$  ..... + 6.82  
 $V_d$  ..... - .09  
 Curvature ..... - .28

Radial velocity ..... +24.5



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$\beta$  ORIONIS 1981.

1908. Nov. 21.  
G. M. T. 19<sup>h</sup> 33<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3651           |                          |  |           | 2   | 58 8100           |                          |  |           |
| 2   | 61 3788           |                          |  |           | 2   | 36 1536           |                          |  |           |
| 3   | 61 2564           | 2540                     | 0417                                   | 17 19     | 1   | 36 1135           | 1120                     | 0639                                   | +22 40    |
| 1½  | 59 6711           | 6700                     | 0462                                   | 18 75     |     |                   |                          |  |           |

Weighted mean ..... + 18 56  
 $V_a$  ..... + 6 82  
 $V_d$  ..... 13  
 Curvature ..... 28  
 Radial velocity ..... + 25 0

$\beta$  ORIONIS 1984.

1908. Nov. 28.  
G. M. T. 16<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3672           |                          |  |           | 2   | 58 8125           |                          |  |           |
| 2   | 61 3818           |                          |  |           | 2   | 36 1472           |                          |  |           |
| 3   | 61 2562           | 2518                     | 0395                                   | +16 28    | 2   | 36 1186           | 1236                     | 0755                                   | +26 47    |
| 1½  | 59 6454           | 6418                     | 0186                                   | 7 34      |     |                   |                          |  |           |

Weighted mean ..... +17 35  
 $V_a$  ..... + 3 79  
 $V_d$  ..... + 15  
 Curvature ..... 28  
 Radial velocity ..... +21 0

$\beta$  ORIONIS 1985.

1908. Nov. 28.  
G. M. T. 16<sup>h</sup> 34<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 4001           |                          |  |           | 2   | 58 8418           |                          |  |           |
| 2   | 61 4112           |                          |  |           | 2   | 36 1728           |                          |  |           |
| 3   | 61 2867           | 2527                     | 0405                                   | +16 65    | 1½  | 36 1352           | 1155                     | 0674                                   | +23 63    |
| 2   | 59 7043           | 6713                     | 0475                                   | 19 37     |     |                   |                          |  |           |

Weighted mean ..... + 19 10  
 $V_a$  ..... + 3 79  
 $V_d$  ..... + 10  
 Curvature ..... 28  
 Radial velocity ..... + 22 7

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$\beta$  ORIONIS 1986.

1908. Nov. 28.  
G. M. T. 17<sup>h</sup> 08<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3743           | .....                    | .....                                   | .....     | 2   | 58.8170           | .....                    | .....                                   | .....     |
| 2   | 61.3865           | .....                    | .....                                   | .....     | 2   | 36.1450           | .....                    | .....                                   | .....     |
| 3   | 61.2439           | 2340                     | .0217                                   | + 8.94    | 2   | 36.1220           | .1290                    | .0869                                   | + 28.36   |
| 1½  | 59.6728           | .6645                    | .0407                                   | 16.60     |     |                   |                          |   |           |

Weighted mean..... +16.91  
 $V_a$ ..... + 3.79  
 $V_d$ ..... + .05  
 Curvature..... - .28  
 Radial velocity..... +20.5

$\beta$  ORIONIS 1987.

1908. Dec. 1.  
G. M. T. 17<sup>h</sup> 53<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3748           | .....                    | .....                                   | .....     | 2   | 58.8267           | .....                    | .....                                   | .....     |
| 2   | 61.3934           | .....                    | .....                                   | .....     | 2   | 36.2127           | .....                    | .....                                   | .....     |
| 2   | 61.2490           | 2005                     | .0200                                   | + 8.33    | 1   | 36.1757           | .1573                    | .0668                                   | + 23.44   |
| 1   | 59.6824           | .6385                    | .0420                                   | 17.13     |     |                   |                          |   |           |

Weighted mean..... +14.31  
 $V_a$ ..... + 2.42  
 $V_d$ ..... - .04  
 Curvature..... - .28  
 Radial velocity..... +16.4

$\beta$  ORIONIS 1988.

1908. Dec. 1.  
G. M. T. 18<sup>h</sup> 18<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3333           | .....                    | .....                                   | .....     | 2   | 58.7876           | .....                    | .....                                   | .....     |
| 2   | 61.3527           | .....                    | .....                                   | .....     | 2   | 36.1671           | .....                    | .....                                   | .....     |
| 2   | 61.2276           | 2515                     | .0392                                   | + 16.16   | 1   | 36.1272           | .1123                    | .0643                                   | + 22.54   |
| 1   | 59.6515           | .6735                    | .0497                                   | 20.27     |     |                   |                          |   |           |

Weighted mean..... +18.78  
 $V_a$ ..... + 2.42  
 $V_d$ ..... - .09  
 Curvature..... - .28  
 Radial velocity..... +20.9

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1908. Dec. 1.  
G. M. T. 18<sup>h</sup> 36<sup>m</sup>

$\beta$  ORIONIS 1989.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3437           |                          |  |           | 2   | 58 7973           |                          |  |           |
| 2   | 61 3587           |                          |  |           | 2   | 36 1794           |                          |  |           |
| 2   | 61 2166           | 2335                     | 0212                                   | + 8 74    | 1½  | 36 1287           | 1015                     | 0535                                   | +18 75    |
| ½   | 59 6620           | 6760                     | 0522                                   | 21 29     |     |                   |                          |  |           |

Weighted mean..... +14 06  
*V<sub>a</sub>*..... + 2 42  
*V<sub>d</sub>*..... 12  
 Curvature..... - 28  
 Radial velocity..... +16 1

1908. Dec. 1.  
G. M. T. 18<sup>h</sup> 52<sup>m</sup>

$\beta$  ORIONIS 1990.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
|     | 63 3478           |                          |  |           |     | 58 8000           |                          |  |           |
|     | 61 3679           |                          |  |           |     | 36 1850           |                          |  |           |
| 3   | 61 2397           | 2520                     | 0397                                   | +16 36    | 1   | 36 1648           | 1320                     | 0839                                   | +29 41    |
| 2   | 59 6724           | 6830                     | 0592                                   | 24 15     |     |                   |                          |  |           |

Weighted mean..... +21 13  
*V<sub>a</sub>*..... + 2 41  
*V<sub>d</sub>*..... 16  
 Curvature..... - 28  
 Radial velocity..... +23 1

1908. Dec. 5.  
G. M. T. 16<sup>h</sup> 10<sup>m</sup>

$\beta$  ORIONIS 2003.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
|     | 63 3465           |                          |  |           |     | 58 8090           |                          |  |           |
|     | 61 3690           |                          |  |           |     | 36 2298           |                          |  |           |
| 3   | 61 2456           | 2215                     | 0410                                   | +16 95    | 1   | 36 2074           | 1715                     | 0810                                   | +28 48    |
| 1½  | 59 6764           | 6518                     | 0553                                   | 22 62     |     |                   |                          |  |           |

Weighted mean..... +22 16  
*V<sub>a</sub>*..... + 63  
*V<sub>d</sub>*..... + 10  
 Curvature..... - 28  
 Radial velocity..... +22 6

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$\gamma$  ORIONIS 2004.

1908. Dec. 5.  
G. M. T. 16<sup>h</sup> 22<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3170           | .....                    | .....                                  | .....     | 2   | 58 7790           | .....                    | .....                                  | .....     |
| 2   | 61 3390           | .....                    | .....                                  | .....     | 2   | 36 1924           | .....                    | .....                                  | .....     |
| 2   | 61 2216           | 2275                     | 0470                                   | 19 43     | 1   | 36 1868           | 1886                     | 0981                                   | -34 49    |
| 1   | 59 6557           | 6610                     | 0635                                   | 25 98     |     |                   |                          |  |           |

Weighted mean ..... +24 67  
*V<sub>a</sub>* ..... + 63  
*V<sub>d</sub>* ..... + 08  
 Curvature ..... - 28  
 Radial velocity ..... -25 1

$\beta$  ORIONIS 2005.

1908. Dec. 5.  
G. M. T. 16<sup>h</sup> 38<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3054           | .....                    | .....                                  | .....     | 2   | 58 7707           | .....                    | .....                                  | .....     |
| 2   | 61 3304           | .....                    | .....                                  | .....     | 2   | 36 1884           | .....                    | .....                                  | .....     |
| 2   | 61 2269           | 2415                     | 0610                                   | 25 22     | 1   | 36 1715           | 1775                     | 0870                                   | +30 59    |
| 1   | 59 6314           | 6450                     | 0485                                   | 19 84     |     |                   |                          |  |           |

Weighted mean ..... +25 22  
*V<sub>a</sub>* ..... + 63  
*V<sub>d</sub>* ..... + 05  
 Curvature ..... 28  
 Radial velocity ..... +25 6

$\beta$  ORIONIS 2006.

1908. Dec. 5.  
G. M. T. 16<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3019           | .....                    | .....                                  | .....     | 2   | 58 7614           | .....                    | .....                                  | .....     |
| 2   | 61 3242           | .....                    | .....                                  | .....     | 2   | 36 1852           | .....                    | .....                                  | .....     |
| 3   | 61 2261           | 2480                     | 0675                                   | +27 90    | 1   | 36 1782           | 1872                     | 0967                                   | +34 00    |
| 1   | 59 6262           | 6480                     | 0515                                   | 21 07     |     |                   |                          |  |           |

Weighted mean ..... +27 14  
*V<sub>a</sub>* ..... + 63  
*V<sub>d</sub>* ..... - 03  
 Curvature ..... - 28  
 Radial velocity ..... +27 5

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$\beta$  ORIONIS 2054.

1908, Dec. 21.  
G. M. T. 15<sup>h</sup> 24<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-------|-------------------|--------------------------|--|-----------|-------|-------------------|--------------------------|--|-----------|
| ..... | 54 7148           | .....                    | .....                                  | .....     | ..... | 53 0909           | .....                    | .....                                  | .....     |
| ..... | 54 0045           | .....                    | .....                                  | .....     | ..... | 45 2924           | .....                    | .....                                  | .....     |
| ..... | 53 9654           | 9630                     | 0198                                   | 22 90     | ..... | 45 2894           | 2907                     | 0318                                   | 33 39     |
| ..... | 53 4020           | 4000                     | 0218                                   | 25 05     | ..... | .....             | .....                    | .....                                  | .....     |

Weighted mean ..... 28 28  
 $V_a$  ..... 6 51  
 $V_d$  ..... 04  
 Curvature ..... 28  
 Radial velocity ..... +21 5

$\beta$  ORIONIS 2055.

1908, Dec. 21.  
G. M. T. 15<sup>h</sup> 29<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7334           | .....                    | .....                                  | .....     | 2   | 53 1065           | .....                    | .....                                  | .....     |
| 2               | 53 9890           | 9690                     | 0258                                   | 29 84     | 1   | 45 2957           | 2907                     | 0318                                   | 33 39     |
| 1 $\frac{1}{2}$ | 53 4172           | 3990                     | 0208                                   | 23 90     | 2   | 45 2891           | .....                    | .....                                  | .....     |

Weighted mean ..... +28 65  
 $V_a$  ..... 6 51  
 $V_d$  ..... 03  
 Curvature ..... 28  
 Radial velocity ..... +21 9

$\beta$  ORIONIS 2057.

1908, Dec. 21.  
G. M. T. 16<sup>h</sup> 54<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| 2   | 56 6288           | .....                    | .....                                  | .....     | 2               | 53 0900           | .....                    | .....                                  | .....     |
| 2   | 54 7099           | .....                    | .....                                  | .....     | 1 $\frac{1}{2}$ | 45 2802           | 2926                     | 0327                                   | +34 34    |
| 2   | 53 9683           | 9695                     | 0263                                   | +30 42    | 2               | 45 2730           | .....                    | .....                                  | .....     |
| 1   | 53 4072           | 4080                     | 0298                                   | 34 24     | .....           | .....             | .....                    | .....                                  | .....     |

Weighted mean ..... +32 57  
 $V_a$  ..... 6 53  
 $V_d$  ..... 07  
 Curvature ..... 28  
 Radial velocity ..... +25 7

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1908. Dec. 21.  
G. M. T. 17<sup>h</sup> 00<sup>m</sup>. $\beta$  ORIONIS 2058.Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 58 6155           |                          |  |           | 2   | 58 0753           |                          |  |           |
| 2   | 51 6935           |                          |  |           | 1½  | 45 2686           | 2853                     | 0267                                     | + 28 04   |
| 1½  | 53 9424           | 9585                     | 0143                                     | + 16 54   | 2   | 45 2681           |                          |  |           |
| 1½  | 53 3996           | 4140                     | 0358                                     | 41 14     |     |                   |                          |  |           |

Weighted mean ..... - 28 91  
*V<sub>a</sub>* ..... - 6 53  
*V<sub>d</sub>* ..... - 07  
 Curvature ..... - 28

Radial velocity ..... + 22 0

 $\beta$  ORIONIS 2065.1908. Dec. 22.  
G. M. T. 17<sup>h</sup> 38<sup>m</sup>.Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3046           |                          |  |           | 2   | 58 7699           |                          |  |           |
| 2   | 61 3280           |                          |  |           | 1   | 36 2329           |                          |  |           |
| 1½  | 61 2436           | 2278                     | 0792                                     | + 32 84   | 2   | 36 2528           | 2560                     | 1230                                     | + 43 38   |
| 2   | 59 6639           | 6520                     | 0828                                     | 33 55     |     |                   |                          |  |           |

Weighted mean ..... - 35 50  
*V<sub>a</sub>* ..... - 6 98  
*V<sub>d</sub>* ..... - 11  
 Curvature ..... - 28

Radial velocity ..... + 28 1

 $\beta$  ORIONIS 2066.1908. Dec. 22.  
G. M. T. 17<sup>h</sup> 52<sup>m</sup>.Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 2896           |                          |  |           | 2   | 58 7610           |                          |  |           |
| 2   | 61 3178           |                          |  |           | 2   | 36 2286           |                          |  |           |
| 3   | 61 2362           | 2220                     | 0734                                     | - 30 43   | 1   | 36 2245           | 2320                     | 0990                                     | + 34 92   |
| 1½  | 59 6270           | 6245                     | 0553                                     | 22 68     |     |                   |                          |  |           |

Weighted mean ..... - 29 13  
*V<sub>a</sub>* ..... - 6 98  
*V<sub>d</sub>* ..... - 12  
 Curvature ..... - 28

Radial velocity ..... + 21 7

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1908. Dec. 22.  
G. M. T. 18<sup>h</sup> 02<sup>m</sup>

$\beta$  ORIONIS 2067.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.2842           |                          |  |           | 2   | 58.7512           |                          |  |           |
| 2   | 61.3040           |                          |  |           | 2   | 36.2038           |                          |  |           |
| 2   | 61.2047           | .2110                    | .0624                                  | +25.87    | 1   | 36.2081           | .2405                    | .1075                                  | +37.92    |
| 1   | 59.6403           | .6480                    | .0788                                  | 32.32     |     |                   |                          |  |           |

Weighted mean..... +30.49  
 $V_a$ ..... - 6.98  
 $V_d$ ..... - .14  
 Curvature..... - .28

Radial velocity..... +23.1

1908. Dec. 22.  
G. M. T. 18<sup>h</sup> 14<sup>m</sup>

$\beta$  ORIONIS 2068.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.2842           |                          |  |           | 2   | 58.7570           |                          |  |           |
| 2   | 61.3115           |                          |  |           | 2   | 36.2160           |                          |  |           |
| 2   | 61.2151           | .2160                    | .0674                                  | +27.94    | 1   | 36.2098           | .2300                    | .0970                                  | +34.21    |
| 1   | 59.6468           | .6483                    | .0791                                  | 32.45     |     |                   |                          |  |           |

Weighted mean..... +30.63  
 $V_a$ ..... - 6.98  
 $V_d$ ..... - .14  
 Curvature..... - .28

Radial velocity..... - 23.2

1908. Dec. 23.  
G. M. T. 14<sup>h</sup> 00<sup>m</sup>

$\beta$  ORIONIS 2070.

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|---------------|-------------------|--------------------------|--|-----------|
| 3               | 63.2758           |                          |  |           | 2             | 58.7363           |                          |  |           |
| 2               | 61.2947           |                          |  |           | 2             | 36.1449           |                          |  |           |
| 3               | 61.1996           | .2490                    | .0685                                  | +28.32    | $\frac{1}{2}$ | 36.1500           | .1990                    | .1085                                  | +38.15    |
| 1 $\frac{1}{2}$ | 59.6100           | .6580                    | .0615                                  | 25.16     |               |                   |                          |  |           |

Weighted mean..... +28.36  
 $V_a$ ..... - 7.36  
 $V_d$ ..... - .18  
 Curvature..... - .28

Radial velocity..... - 20.9

9-10 EDWARD VII., A. 1910

1908, Dec. 23,  
G. M. T. 14<sup>h</sup> 40<sup>m</sup>

3 ORIONIS 2071.

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. |
|-----|-------------------|--------------------------|---------------|-----------|-----|-------------------|--------------------------|---------------|-----------|
| 2   | 63 3263           |                          |               |           | 2   | 58 7844           |                          |               |           |
| 2   | 61 3499           |                          |               |           | 2   | 36 2102           |                          |               |           |
| 3   | 61 2612           | 2580                     | 0775          | -32 04    | 1   | 36 2124           | 1964                     | 1059          | +37 23    |
| 1   | 59 6928           | 6920                     | 0935          | 38 25     |     |                   |                          |               |           |

Weighted mean ..... +34 32  
 $V_a$  ..... - 7 36  
 $V_d$  ..... - 12  
 Curvature ..... - 28  
 Radial velocity ..... -26 8

3 ORIONIS 2072.

1908, Dec. 23,  
G. M. T. 15<sup>h</sup> 08<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. |
|-----|-------------------|--------------------------|---------------|-----------|-----|-------------------|--------------------------|---------------|-----------|
| 2   | 63 3214           |                          |               |           | 2   | 58 7812           |                          |               |           |
| 2   | 61 3398           |                          |               |           | 2   | 36 2100           |                          |               |           |
| 2   | 61 2460           | 2500                     | 0695          | -28 73    | 1   | 36 2132           | 1995                     | 1090          | +38 32    |
| 1   | 59 6670           | 6703                     | 0738          | 30 19     |     |                   |                          |               |           |

Weighted mean ..... -31 99  
 $V_a$  ..... - 7 36  
 $V_d$  ..... + 09  
 Curvature ..... - 28  
 Radial velocity ..... +23 5

3 ORIONIS 2073.

1908, Dec. 23,  
G. M. T. 15<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in revs | Velocity. |
|-----|-------------------|--------------------------|---------------|-----------|-----|-------------------|--------------------------|---------------|-----------|
| 2   | 63 2965           |                          |               |           | 2   | 58 7615           |                          |               |           |
| 2   | 61 3207           |                          |               |           | 2   | 36 1916           |                          |               |           |
| 3   | 61 2222           | 2470                     | 0665          | -27 49    | 1   | 36 1928           | 1954                     | 1049          | +36 88    |
| 1   | 59 6362           | 6395                     | 0630          | 25 77     |     |                   |                          |               |           |

Weighted mean ..... +28 73  
 $V_a$  ..... - 7 36  
 $V_d$  ..... + 07  
 Curvature ..... - 28  
 Radial velocity ..... +21 2



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1908, Dec. 26,  
G. M. T. 15<sup>h</sup> 50<sup>m</sup>

$\beta$  ORIONIS 2075.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 33' 19        |                          |   |           | 2   | 58° 7' 77         |                          |   |           |
| 2   | 61° 33' 25        |                          |   |           | 2   | 36° 18' 51        |                          |   |           |
| 3   | 61° 20' 97        | 2622                     | 0817                                    | 33 77     | 1½  | 36° 17' 91        | 1882                     | 0977                                    | 31 45     |
| 1½  | 59° 6' 90         | 6850                     | 0885                                    | 36 21     |     |                   |                          |   |           |

Weighted mean ..... +34 52  
 $V_a$  ..... - 8 68  
 $V_d$  ..... - 01  
 Curvature..... - 28  
 Radial velocity ..... - 25 6

$\beta$  ORIONIS 2076.

1908, Dec. 26,  
G. M. T. 16<sup>h</sup> 00<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 30' 51        |                          |   |           | 2   | 58° 7' 573        |                          |   |           |
| 2   | 61° 32' 04        |                          |   |           | 2   | 36° 16' 24        |                          |   |           |
| 3   | 61° 23' 57        | 2590                     | 0785                                    | +32 45    | 1½  | 36° 16' 30        | 1950                     | 1045                                    | +36 74    |
| 1½  | 59° 6' 14         | 6874                     | 0919                                    | 37 60     |     |                   |                          |   |           |

Weighted mean ..... +34 81  
 $V_a$  ..... - 8 68  
 $V_d$  ..... - 01  
 Curvature..... - 28  
 Radial velocity..... - 25 9

$\beta$  ORIONIS 2077.

1908, Dec. 26,  
G. M. T. 16<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63° 34' 24        |                          |   |           | 2   | 58° 7' 943        |                          |   |           |
| 2   | 61° 36' 08        |                          |   |           | 2   | 36° 19' 93        |                          |   |           |
| 3   | 61° 26' 12        | 2450                     | 0645                                    | 26 66     | 1½  | 36° 21' 32        | 2082                     | 1177                                    | +41 38    |
| 1½  | 59° 6' 42         | 6736                     | 0765                                    | 31 30     |     |                   |                          |   |           |

Weighted mean ..... +31 48  
 $V_a$  ..... - 8 68  
 $V_d$  ..... - 02  
 Curvature..... - 28  
 Radial velocity..... +22 5

1908. Dec. 26.  
G. M. T. 16<sup>h</sup> 18<sup>m</sup>

$\beta$  ORIONIS 2078.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|---------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2             | 63 3147           |                          |  |           | 2   | 58 7681           |                          |  |           |
| 2             | 61 3334           |                          |  |           | 2   | 36 1610           |                          |  |           |
| 2             | 61 2290           | 2110                     | 0605                                   | +25.01    | 1   | 36 1567           | 1900                     | 0995                                   | +34.98    |
| $\frac{1}{2}$ | 59 6970           | 7120                     | 1135                                   | 46.45     |     |                   |                          |  |           |

Weighted mean..... +30.92  
 $V_a$ ..... - 8.68  
 $V_d$ ..... - .04  
 Curvature..... - .28  
 Radial velocity..... +22.0

1908. Dec. 27.  
G. M. T. 14<sup>h</sup> 07<sup>m</sup>

$\beta$  ORIONIS 2079.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3248           |                          |  |           | 2   | 58 7809           |                          |  |           |
| 2   | 61 3453           |                          |  |           | 2   | 36 1593           |                          |  |           |
| 3   | 61 2754           | 2750                     | 0945                                   | +39.07    | 1   | 36 1787           | 2140                     | 1235                                   | +43.42    |
| 2   | 59 7087           | 7115                     | 1150                                   | 47.05     |     |                   |                          |  |           |

Weighted mean..... +42.45  
 $V_a$ ..... - 9.08  
 $V_d$ ..... + .15  
 Curvature..... - .28  
 Radial velocity..... +33.2

1908. Dec. 27.  
G. M. T. 15<sup>h</sup> 10<sup>m</sup>

$\beta$  ORIONIS 2080.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3501           |                          |  |           | 2   | 58 8064           |                          |  |           |
| 2   | 61 3730           |                          |  |           | 2   | 36 1823           |                          |  |           |
| 3   | 61 3054           | 2780                     | 0975                                   | +40.31    | 1   | 36 1975           | 2095                     | 1190                                   | +41.84    |
| 1   | 59 7017           | 6790                     | 0825                                   | 33.75     |     |                   |                          |  |           |

Weighted mean..... +39.02  
 $V_a$ ..... - 9.08  
 $V_d$ ..... + .05  
 Curvature..... - .28  
 Radial velocity..... +29.7

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$\beta$  ORIONIS 2082.

1908. Dec. 31.  
G. M. T. 15<sup>h</sup> 19<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------|-----------|-----|-------------------|--------------------------|---------------------------|-----------|
| 2   | 54 7142           |                          |                           |           | 2   | 53 0938           |                          |                           |           |
| 2   | 54 0115           |                          |                           |           | 2   | 45 2860           | 2855                     | 0368                      | +38 53    |
| 2   | 53 9684           | 9790                     | 0224                      | +25 84    | 2   | 45 2716           |                          |                           |           |
| 2   | 53 4146           | 4225                     | 0323                      | 37 03     |     |                   |                          |                           |           |

Weighted mean..... + 33 80  
 $V_a$ ..... 10 77  
 $V_d$ ..... 00  
 Curvature..... 28

Radial velocity ..... + 22 7

$\beta$  ORIONIS 2083.

1908. Dec. 31.  
G. M. T. 15<sup>h</sup> 23<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------|-----------|-----|-------------------|--------------------------|---------------------------|-----------|
| 2   | 54 7063           |                          |                           |           | 2   | 53 0866           |                          |                           |           |
| 2   | 54 0015           |                          |                           |           | 1½  | 45 2868           | 2850                     | 0363                      | +38 00    |
| 2   | 53 9690           | 9860                     | 0294                      | 33 92     | 2   | 45 2719           |                          |                           |           |
| 1   | 53 4065           | 4215                     | 0313                      | 35 88     |     |                   |                          |                           |           |

Weighted mean..... + 35 72  
 $V_a$ ..... 10 77  
 $V_d$ ..... 00  
 Curvature..... 28

Radial velocity ..... + 24 7

$\beta$  ORIONIS 2084.

1908. Dec. 31.  
G. M. T. 15<sup>h</sup> 29<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------|-----------|-----|-------------------|--------------------------|---------------------------|-----------|
| 2   | 54 6938           |                          |                           |           | 2   | 53 0745           |                          |                           |           |
| 2   | 53 9878           |                          |                           |           | 2   | 45 2702           | 2812                     | 0325                      | +34 02    |
| 2   | 53 9587           | 9880                     | 0314                      | +36 23    | 2   | 45 2690           |                          |                           |           |
| 1   | 53 3888           | 4169                     | 0258                      | 29 57     |     |                   |                          |                           |           |

Weighted mean..... + 34 01  
 $V_a$ ..... 10 77  
 $V_d$ ..... 00  
 Curvature..... 28

Radial velocity ..... + 23 0

9-10 EDWARD VII., A. 1910

1908. Dec. 31.  
G. M. T. 15<sup>h</sup> 57<sup>m</sup>

3 ORIONIS 2085.

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 6397           |                          |  |           | 2   | 53 0777           |                          |  |           |
| 2   | 53 9927           |                          |  |           | 2   | 45 2854           | 2895                     | 0408                                   | + 42 71   |
| 3   | 53 9592           | 9835                     | 0269                                   | - 31 03   | 2   | 45 2717           |                          |  |           |
| 1½  | 53 4022           | 4255                     | 0353                                   | 40 46     |     |                   |                          |  |           |

Weighted mean ..... - 37 57  
 $V_a$  ..... - 10 77  
 $V_d$  ..... - 00  
 Curvature ..... - 28  
 Radial velocity ..... - 26 5

3 ORIONIS 2092.

1909. Jan. 6.  
G. M. T. 16<sup>h</sup> 49<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7150           |                          |  |           | 2   | 53 0905           |                          |  |           |
| 2   | 54 0102           |                          |  |           | 1½  | 45 2713           | 2730                     | 0243                                   | + 25 44   |
| 3   | 53 9756           | 9860                     | 0294                                   | - 33 92   | 2   | 45 2734           |                          |  |           |
| 1½  | 53 4128           | 4230                     | 0328                                   | 37 50     |     |                   |                          |  |           |

Weighted mean ..... - 32 72  
 $V_a$  ..... - 13 21  
 $V_d$  ..... - 16  
 Curvature ..... - 28  
 Radial velocity ..... + 19 1

3 ORIONIS 2093.

1909. Jan. 6.  
G. M. T. 16<sup>h</sup> 53<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7120           |                          |  |           | 2   | 53 0884           |                          |  |           |
| 2   | 54 0046           |                          |  |           | 2   | 45 2787           | 2750                     | 0263                                   | + 27 43   |
| 3   | 53 9727           | 9860                     | 0294                                   | - 33 92   | 2   | 45 2773           |                          |  |           |
| 1½  | 53 4136           | 4250                     | 0348                                   | 39 89     |     |                   |                          |  |           |

Weighted mean ..... + 33 30  
 $V_a$  ..... - 13 21  
 $V_d$  ..... - 16  
 Curvature ..... - 28  
 Radial velocity ..... - 19 6

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$\gamma$  ORIONIS 2034.

1909. Jan. 6.  
G. M. T. 17<sup>h</sup> 13<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7235           |                          |  |           | 2   | 53 1074           |                          |  |           |
| 2   | 54 0160           |                          |  |           | 2   | 15 2957           | 2830                     | 0343                                     | +35 81    |
| 3   | 53 9867           | 9850                     | 0284                                     | -32 77    | 2   | 15 2876           |                          |  |           |
| 2   | 53 4193           | 4143                     | 0241                                     | 27 63     |     |                   |                          |  |           |

Weighted mean ..... +32 17  
 $V_a$  ..... 13 21  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... +18 5

$\delta$  ORIONIS 2035.

1909. Jan. 6.  
G. M. T. 17<sup>h</sup> 16<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 56 6440           |                          |  |           | 2   | 53 0990           |                          |  |           |
| 2   | 54 7198           |                          |  |           | 2   | 45 2880           | 2815                     | 0328                                     | +34 34    |
| 2   | 53 9780           | 9830                     | 0264                                     | +30 46    | 2   | 45 2821           |                          |  |           |
| 1   | 53 4356           | 4380                     | 0478                                     | 54 79     |     |                   |                          |  |           |

Weighted mean ..... +34 89  
 $V_a$  ..... -13 21  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... +21 2

$\beta$  ORIONIS 2105.

1909. Jan. 7.  
G. M. T. 12<sup>h</sup> 49<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7033           |                          |  |           | 2   | 53 0832           |                          |  |           |
| 2   | 53 9964           |                          |  |           | 1   | 45 2868           |                          |  |           |
| 3   | 53 9532           | 9600                     | 0168                                     | +19 43    | 2   | 45 2834           | 2902                     | 0313                                     | +32 87    |
| 1½  | 53 4150           | 4215                     | 0433                                     | 49 76     |     |                   |                          |  |           |

Weighted mean ..... +30 57  
 $V_a$  ..... -13 59  
 $V_d$  ..... 11  
 Curvature ..... 28  
 Radial velocity ..... +16 8

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 $\beta$  ORIONIS 2106.1909. Jan. 7.  
G. M. T. 13<sup>h</sup> 01<sup>m</sup>Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54·7102           | .....                    | .....                                  | .....     | 2   | 53·0883           | .....                    | .....                                  | .....     |
| 2   | 54·0642           | .....                    | .....                                  | .....     | 2   | 45·2895           | .....                    | .....                                  | .....     |
| 3   | 53·9710           | ·9725                    | ·0293                                  | +33·89    | 1½  | 45·2880           | ·2920                    | ·0331                                  | +34·76    |
| 2   | 53·4114           | ·4125                    | ·0343                                  | 39·41     |     |                   |                          |  |           |

Weighted mean ..... +35·79  
 $V_a$  ..... -13·59  
 $V_d$  ..... ·11  
 Curvature ..... ·28

Radial velocity ..... +21·9

 $\beta$  ORIONIS 2107.1909. Jan. 7.  
G. M. T. 13<sup>h</sup> 04<sup>m</sup>Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54·7028           | .....                    | .....                                  | .....     | 2   | 53·0852           | .....                    | .....                                  | .....     |
| 2   | 54·0000           | .....                    | .....                                  | .....     | 2   | 36·2832           | .....                    | .....                                  | .....     |
| 3   | 53·9603           | ·9653                    | ·0221                                  | +25·56    | 1½  | 36·2708           | ·2810                    | ·0221                                  | +23·21    |
| 1½  | 53·4016           | ·4060                    | ·0278                                  | 31·94     |     |                   |                          |  |           |

Weighted mean ..... +26·57  
 $V_a$  ..... -13·59  
 $V_d$  ..... ·11  
 Curvature ..... ·28

Radial velocity ..... +12·8

 $\beta$  ORIONIS 2108.1909. Jan. 7.  
G. M. T. 13<sup>h</sup> 07<sup>m</sup>Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54·7190           | .....                    | .....                                  | .....     | 2   | 53·0925           | .....                    | .....                                  | .....     |
| 1   | 54·0072           | .....                    | .....                                  | .....     | 2   | 45·2938           | .....                    | .....                                  | .....     |
| 2½  | 53·9772           | ·9715                    | ·0283                                  | +32·73    | 2   | 45·2933           | ·2931                    | ·0342                                  | +35·91    |
| 1½  | 53·4133           | ·4097                    | ·0315                                  | 36·20     |     |                   |                          |  |           |

Weighted mean ..... +34·66  
 $V_a$  ..... -13·59  
 $V_d$  ..... ·11  
 Curvature ..... ·28

Radial velocity ..... -20·7

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$\beta$  ORIONIS 2111.

1909. Jan. 7.  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3019           | .....                    | .....                                  | .....     | 2   | 58.7700           | .....                    | .....                                  | .....     |
| 2   | 61.3278           | .....                    | .....                                  | .....     | 1½  | 36.2038           | 2023                     | 0693                                   | +24.46    |
| 2   | 61.2471           | 2315                     | 0829                                   | +34.37    | 2   | 36.2253           | .....                    | .....                                  | .....     |
| 1   | 59.6883           | 6760                     | 1968                                   | 43.81     |     |                   |                          |  |           |

Weighted mean ..... + 33.16  
 $V_a$  ..... - 13.59  
 $V_d$  ..... - 11  
 Curvature ..... - 28

Radial velocity ..... +19.2

$\beta$  ORIONIS 2112.

1909. Jan. 7.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.2779           | .....                    | .....                                  | .....     | 2   | 58.7484           | .....                    | .....                                  | .....     |
| 2   | 61.3033           | .....                    | .....                                  | .....     | 1½  | 36.2003           | 2120                     | 0790                                   | +27.86    |
| 3   | 61.2146           | 2236                     | 0750                                   | +31.51    | 2   | 36.2131           | .....                    | .....                                  | .....     |
| 2   | 59.6353           | 6455                     | 0763                                   | 31.30     |     |                   |                          |  |           |

Weighted mean ..... + 30.60  
 $V_a$  ..... - 13.59  
 $V_d$  ..... - 11  
 Curvature ..... - 28

Radial velocity ..... +16.6

$\beta$  ORIONIS 2114.

1909. Jan. 7.  
G. M. T. 16<sup>h</sup> 56<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.2829           | .....                    | .....                                  | .....     | 1   | 58.7582           | .....                    | .....                                  | .....     |
| 2   | 61.3072           | .....                    | .....                                  | .....     | 1½  | 36.1955           | 2045                     | 0715                                   | +25.22    |
| 3   | 61.2181           | 2220                     | 0734                                   | +30.43    | 2   | 36.2146           | .....                    | .....                                  | .....     |
| 1½  | 59.6679           | 6695                     | 1003                                   | 41.14     |     |                   |                          |  |           |

Weighted mean ..... + 31.80  
 $V_a$  ..... - 13.59  
 $V_d$  ..... - 11  
 Curvature ..... - 28

Radial velocity ..... +17.8

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$\beta$  ORIONIS 2117.

1909. Jan. 8.  
G. M. T. 15<sup>h</sup> 48<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.6880           |                          |  |           | 2   | 53.0662           |                          |  |           |
| 1   | 53.9760           |                          |  |           | 2   | 45.2638           | 2850                     | 0261                                   | -27.41    |
| 2   | 53.9517           | 9750                     | 0318                                   | -36.78    | 2   | 45.2622           |                          |  |           |
| 1   | 53.3882           | 4113                     | 0331                                   | 38.01     |     |                   |                          |  |           |

Weighted mean..... + 33.28  
 $V_a$ ..... - 13.96  
 $V_d$ ..... - .09  
 Curvature..... - .28  
 Radial velocity..... + 18.9

$\beta$  ORIONIS 2118.

1909. Jan. 8.  
G. M. T. 15<sup>h</sup> 52<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7077           |                          |  |           | 2   | 53.0872           |                          |  |           |
| 2   | 53.9948           |                          |  |           | 2   | 45.2898           | 2935                     | 0346                                   | +36.33    |
| 2   | 53.9690           | 9730                     | 0298                                   | -34.47    | 2   | 45.2837           |                          |  |           |
| 1   | 53.4030           | 4060                     | 0278                                   | 31.84     |     |                   |                          |  |           |

Weighted mean..... + 34.69  
 $V_a$ ..... - 13.96  
 $V_d$ ..... - .09  
 Curvature..... - .28  
 Radial velocity..... + 20.3

$\beta$  ORIONIS 2122.

1909. Jan. 12.  
G. M. T. 11<sup>h</sup> 55<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7074           |                          |  |           | 2   | 53.0858           |                          |  |           |
| 2   | 53.9968           |                          |  |           | 2   | 45.2886           |                          |  |           |
| 1   | 53.9694           | 9735                     | 0303                                   | +33.80    | 2   | 45.2856           | 2905                     | 0316                                   | +34.92    |
| 2   | 53.4238           | 4275                     | 0493                                   | 54.97     |     |                   |                          |  |           |

Weighted mean..... + 41.91  
 $V_a$ ..... - 15.39  
 $V_d$ ..... + .23  
 Curvature..... - .28  
 Radial velocity..... + 26.5



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$\gamma$  ORIONIS 2123.

1909. Jan. 12.  
G. M. T. 11<sup>h</sup> 59<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7088           |                          |  |           | 2   | 53 0880           |                          |  |           |
| 2   | 53 9990           |                          |  |           | 2   | 45 2791           |                          |  |           |
| 3   | 53 9836           | 9836                     | 0128                                   | 47 75     | 1   | 45 2727           | 2890                     | 0301                                   | 33 26     |
| 2   | 53 4085           | 4105                     | 0323                                   | 36 01     |     |                   |                          |  |           |

Weighted mean ..... 41 42  
 $V_a$  ..... 15 39  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... 26 0

$\beta$  ORIONIS 2124.

1909. Jan. 12.  
G. M. T. 12<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7008           |                          |  |           | 2   | 53 0750           |                          |  |           |
| 2               | 53 9928           |                          |  |           | 2   | 45 2813           |                          |  |           |
| 3               | 53 9538           | 9700                     | 0268                                   | 29 90     | 2   | 45 2783           | 2905                     | 0316                                   | 34 92     |
| 1 $\frac{1}{2}$ | 53 4100           | 4225                     | 0443                                   | 49 39     |     |                   |                          |  |           |

Weighted mean ..... 35 97  
 $V_a$  ..... 15 39  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... 20 5

$\beta$  ORIONIS 2125.

1909. Jan. 12.  
G. M. T. 12<sup>h</sup> 12<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7110           |                          |  |           | 2   | 53 0858           |                          |  |           |
| 2   | 54 0045           |                          |  |           | 2   | 45 2870           |                          |  |           |
| 4   | 53 9770           | 9775                     | 0343                                   | 38 27     | 2   | 45 2840           | 2905                     | 0316                                   | 34 92     |
| 3   | 53 4077           | 4105                     | 0323                                   | 36 01     |     |                   |                          |  |           |

Weighted mean ..... +36 77  
 $V_a$  ..... -15 39  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... +21 3

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 $\beta$  ORIONIS 2125.1909, Jan. 12.  
G. M. T. 12<sup>h</sup> 15<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7047           |                          |  |           | 2   | 53 0813           |                          |  |           |
| 2               | 54 0000           |                          |  |           | 2   | 45 2910           |                          |  |           |
| 2 $\frac{1}{2}$ | 53 9770           | 9830                     | 0398                                   | +44 40    | 1   | 45 2885           | 2910                     | 0321                                   | +35 47    |
| 1 $\frac{1}{2}$ | 53 4113           | 4180                     | 0398                                   | 44 37     |     |                   |                          |  |           |

Weighted mean ..... +42 60  
 $V_a$  ..... -15 39  
 $V_d$  ..... + 23  
 Curvature ..... - 28  
 Radial velocity ..... +27.2

 $\beta$  ORIONIS 2127.1909, Jan. 12  
G. M. T. 12<sup>h</sup> 18<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7144           |                          |  |           | 2   | 53 0960           |                          |  |           |
| 2               | 54 0082           |                          |  |           | 2   | 45 2991           |                          |  |           |
| 2 $\frac{1}{2}$ | 53 9767           | 9765                     | 0333                                   | -37 15    | 2   | 45 3000           | 2945                     | 0356                                   | +39 34    |
| 1 $\frac{1}{2}$ | 53 4291           | 4224                     | 0442                                   | 49 28     |     |                   |                          |  |           |

Weighted mean ..... +40 91  
 $V_a$  ..... -15 39  
 $V_d$  ..... + 23  
 Curvature ..... - 28  
 Radial velocity ..... -25.5

 $\beta$  ORIONIS 2128.1909, Jan. 13.  
G. M. T. 15<sup>h</sup> 33<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7086           |                          |  |           | 2   | 53 0920           |                          |  |           |
| 2   | 54 0031           |                          |  |           | 2   | 45 2968           |                          |  |           |
| 2   | 53 9775           | 9790                     | 0358                                   | +41 41    | 2   | 45 3012           | 2980                     | 0391                                   | +41 06    |
| 2   | 53 4281           | 4275                     | 0493                                   | 56 65     |     |                   |                          |  |           |

Weighted mean ..... +46 37  
 $V_a$  ..... -15 81  
 $V_d$  ..... - 99  
 Curvature ..... - 28  
 Radial velocity ..... +30.2

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$\beta$  ORIONIS 2129.

1909. Jan. 13.  
G. M. T. 15<sup>h</sup> 41<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7082           | .....                    | .....                                  | .....     | 2   | 53 0893           | .....                    | .....                                  | .....     |
| 2   | 54 0002           | .....                    | .....                                  | .....     | 2   | 45 2978           | .....                    | .....                                  | .....     |
| 2½  | 53 9730           | 9748                     | 0316                                   | +36 54    | 1½  | 45 2852           | 2810                     | 0221                                   | +23 20    |
| 1½  | 53 4061           | 4068                     | 0286                                   | 32 86     |     |                   |                          |  |           |

Weighted mean..... +31 90  
 $V_a$ ..... 15 81  
 $V_d$ ..... 09  
 Curvature..... 28  
 Radial velocity..... -15 7

$\beta$  ORIONIS 2130.

1909. Jan. 13.  
G. M. T. 15<sup>h</sup> 46<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 6985           | .....                    | .....                                  | .....     | 2   | 53 0813           | .....                    | .....                                  | .....     |
| 2   | 53 9934           | .....                    | .....                                  | .....     | 2   | 45 2892           | .....                    | .....                                  | .....     |
| 2   | 53 9782           | 9880                     | 0448                                   | +51 82    | 2   | 45 2940           | 2984                     | 0395                                   | +41 48    |
| 1   | 53 4029           | 4115                     | 0333                                   | 38 26     |     |                   |                          |  |           |

Weighted mean..... +44 97  
 $V_a$ ..... -15 81  
 $V_d$ ..... 09  
 Curvature..... 28  
 Radial velocity..... -28 8

$\beta$  ORIONIS 2142.

1909. Jan. 15.  
G. M. T. 15<sup>h</sup> 11<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7058           | .....                    | .....                                  | .....     | 2   | 53 0911           | .....                    | .....                                  | .....     |
| 2   | 53 9996           | .....                    | .....                                  | .....     | 2   | 45 2970           | .....                    | .....                                  | .....     |
| 1   | 53 9752           | 9790                     | 0358                                   | +41 40    | 2   | 45 3055           | 3021                     | 0432                                   | +45 36    |
| 2   | 53 4083           | 4105                     | 0323                                   | 37 14     |     |                   |                          |  |           |

Weighted mean..... +41 28  
 $V_a$ ..... -16 50  
 $V_d$ ..... 04  
 Curvature..... 28  
 Radial velocity..... -24 5

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1909. Jan. 15.  
G. M. T. 14<sup>h</sup> 54<sup>m</sup>

$\beta$  ORIONIS 2141.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in Rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 56 6150           |                          |   |           | 2   | 53 0735           |                          |   |           |
| 2   | 54 7025           |                          |   |           | 2   | 45 2772           |                          |   |           |
| 2   | 53 9628           | 9778                     | 0346                                    | -40 02    | 3   | 45 2777           | 2940                     | 0351                                    | +36 86    |
| 1   | 53 3821           | 3975                     | 0193                                    | 22 18     |     |                   |                          |   |           |

Weighted mean ..... +35 47  
 $V_a$  ..... -16 50  
 $V_d$  ..... 04  
 Curvature..... - 28  
 Radial velocity..... 18 6

1909. Jan. 15.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

$\beta$  ORIONIS 2143.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54 7162           |                          |   |           | 2   | 53 0946           |                          |   |           |
| 2   | 54 0069           |                          |   |           | 2   | 45 2937           |                          |   |           |
| 3   | 53 9695           | 9814                     | 0412                                    | -47 65    | 2   | 45 3062           | 3061                     | 0472                                    | +49 56    |
| 1½  | 53 4092           | 4040                     | 0258                                    | 29 65     |     |                   |                          |   |           |

Weighted mean ..... + 44 08  
 $V_a$  ..... -16 50  
 $V_d$  ..... 04  
 Curvature..... - 28  
 Radial velocity..... +27 2

1909. Jan. 15.  
G. M. T. 15<sup>h</sup> 19<sup>m</sup>

$\beta$  ORIONIS 2144.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54 7053           |                          |   |           | 2   | 53 0782           |                          |   |           |
| 2   | 53 9945           |                          |   |           | 2   | 45 2864           |                          |   |           |
| 1   | 53 9672           | 9750                     | 0318                                    | +36 78    | 2   | 45 2847           | 2920                     | 0331                                    | +34 76    |
| 1   | 53 4103           | 4200                     | 0118                                    | 48 03     |     |                   |                          |   |           |

Weighted mean ..... + 38 58  
 $V_a$  ..... -16 50  
 $V_d$  ..... 04  
 Curvature..... - 28  
 Radial velocity..... +21 8

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3 ORIONIS 2151.

1909, Jan. 16,  
G. M. T. 12<sup>h</sup> 25<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 54° 6926          |                          |                                       |           | 2   | 53° 0657          |                          |                                       |           |
| 2   | 53° 9756          |                          |                                       |           | 2   | 45° 2780          |                          |                                       |           |
| 1   | 53° 9598          | 9850                     | 0418                                  | 48° 25    | 3   | 45° 2970          | 3130                     | 0541                                  | 56° 61    |
| 2   | 53° 3854          | 4104                     | 0322                                  | 56° 00    |     |                   |                          |                                       |           |

Weighted mean ..... 48° 35  
 $V_a$  ..... 16° 82  
 $V_d$  ..... 13  
 Curvature ..... 28  
 Radial velocity ..... 31.4

3 ORIONIS 2152.

1909, Jan. 16,  
G. M. T. 12<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 54° 6990          |                          |                                       |           | 2   | 53° 0859          |                          |                                       |           |
| 2   | 53° 9982          |                          |                                       |           | 2   | 45° 2919          |                          |                                       |           |
| 2   | 53° 9738          | 9820                     | 0388                                  | 44° 78    | 2   | 45° 2978          | 2995                     | 0406                                  | 42° 63    |
| 1   | 53° 4168          | 4210                     | 0428                                  | 48° 18    |     |                   |                          |                                       |           |

Weighted mean ..... 44° 60  
 $V_a$  ..... 16° 82  
 $V_d$  ..... + 13  
 Curvature ..... 28  
 Radial velocity ..... 27.6

3 ORIONIS 2153.

1909, Jan. 16,  
G. M. T. 12<sup>h</sup> 44<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 54° 7003          |                          |                                       |           | 2   | 53° 0787          |                          |                                       |           |
| 2   | 54° 0022          |                          |                                       |           | 2   | 45° 2970          |                          |                                       |           |
| 2   | 53° 9786          | 9886                     | 0454                                  | 52° 51    | 3   | 45° 3131          | 3100                     | 0511                                  | 53° 66    |
| 1   | 53° 4072          | 4160                     | 0378                                  | 43° 44    |     |                   |                          |                                       |           |

Weighted mean ..... 51° 38  
 $V_a$  ..... 16° 82  
 $V_d$  ..... 13  
 Curvature ..... 28  
 Radial velocity ..... 34.4

1909. Jan. 16.  
G. M. T. 12<sup>h</sup> 52<sup>m</sup>

$\beta$  ORIONIS 2154.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           | Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           |
|-----|----------------------|--------------------------|----------------------------|---------------------|-----|----------------------|--------------------------|----------------------------|---------------------|
| 2   | 56 <sup>o</sup> 6114 | .....                    | .....                      | .....               | 2   | 53 <sup>o</sup> 0724 | .....                    | .....                      | .....               |
| 2   | 54 <sup>o</sup> 6911 | .....                    | .....                      | .....               | 2   | 45 <sup>o</sup> 2845 | .....                    | .....                      | .....               |
| 2   | 53 <sup>o</sup> 9844 | 0025                     | 0593                       | +68 <sup>o</sup> 59 | 2   | 45 <sup>o</sup> 3008 | 3100                     | 0511                       | +53 <sup>o</sup> 66 |
| 1½  | 53 <sup>o</sup> 4059 | 4220                     | 0438                       | 49 <sup>o</sup> 23  |     |                      |                          |                            |                     |

Weighted mean..... + 57<sup>o</sup> 88  
 $V_a$ ..... -16<sup>o</sup> 82  
 $V_d$ ..... + 13  
 Curvature..... - 28  
 Radial velocity..... + 40<sup>o</sup> 9

1909. Jan. 16.  
G. M. T. 12<sup>h</sup> 59<sup>m</sup>

$\beta$  ORIONIS 2155.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           | Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           |
|-----|----------------------|--------------------------|----------------------------|---------------------|-----|----------------------|--------------------------|----------------------------|---------------------|
| 2   | 56 <sup>o</sup> 6278 | .....                    | .....                      | .....               | 2   | 53 <sup>o</sup> 4202 | 4220                     | 0438                       | 49 <sup>o</sup> 23  |
| 2   | 54 <sup>o</sup> 7078 | .....                    | .....                      | .....               | 2   | 53 <sup>o</sup> 0880 | .....                    | .....                      | .....               |
| 2   | 54 <sup>o</sup> 0014 | .....                    | .....                      | .....               | 2   | 45 <sup>o</sup> 2940 | .....                    | .....                      | .....               |
| 2   | 53 <sup>o</sup> 9853 | 9875                     | 0443                       | +51 <sup>o</sup> 03 | 2   | 45 <sup>o</sup> 3136 | 3130                     | 0541                       | +53 <sup>o</sup> 66 |

Weighted mean..... + 51<sup>o</sup> 01  
 $V_a$ ..... -16<sup>o</sup> 82  
 $V_d$ ..... + 13  
 Curvature..... - 28  
 Radial velocity..... + 33<sup>o</sup> 0

1909. Jan. 16.  
G. M. T. 13<sup>h</sup> 12<sup>m</sup>

$\beta$  ORIONIS 2156.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           | Wt. | Mean of Settings.    | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity.           |
|-----|----------------------|--------------------------|----------------------------|---------------------|-----|----------------------|--------------------------|----------------------------|---------------------|
| 2   | 54 <sup>o</sup> 7101 | .....                    | .....                      | .....               | 2   | 53 <sup>o</sup> 0934 | .....                    | .....                      | .....               |
| 2   | 54 <sup>o</sup> 0028 | .....                    | .....                      | .....               | 2   | 45 <sup>o</sup> 3008 | .....                    | .....                      | .....               |
| 4   | 53 <sup>o</sup> 9856 | 9845                     | 0413                       | +47 <sup>o</sup> 77 | 3   | 45 <sup>o</sup> 3214 | 3140                     | 0551                       | +58 <sup>o</sup> 91 |
| 2   | 53 <sup>o</sup> 4297 | 4250                     | 0468                       | 53 <sup>o</sup> 78  |     |                      |                          |                            |                     |

Weighted mean..... + 52<sup>o</sup> 82  
 $V_a$ ..... -16<sup>o</sup> 82  
 $V_d$ ..... - 13  
 Curvature..... - 28  
 Radial velocity..... + 35<sup>o</sup> 8

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$\beta$  ORIONIS 2157.

1909, Jan. 17.  
G. M. T. 13<sup>h</sup> 48<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.6992           |                          |   |           | 2   | 53.9802           |                          |   |           |
| 2   | 53.9936           |                          |   |           | 2   | 45.2896           |                          |   |           |
| 3   | 53.9741           |                          | 0418                                    | +48.34    | 2   | 45.3062           | 3102                     | 0513                                    | +53.87    |
| 1   | 53.3965           | 953                      | 0273                                    | 31.37     |     |                   |                          |   |           |

Weighted mean..... +47.35  
 $V_a$ ..... -17.17  
 $V_d$ ..... +.05  
 Curvature..... .28  
 Radial velocity..... +29.9

$\beta$  ORIONIS 2158.

1909, Jan. 17.  
G. M. T. 13<sup>h</sup> 56<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.6898           |                          |   |           | 2   | 53.0742           |                          |   |           |
| 2   | 53.9898           |                          |   |           | 2   | 45.2874           |                          |   |           |
| 2   | 53.9655           | 9835                     | 0403                                    | +46.61    | 2   | 45.2947           | 3010                     | 0421                                    | +44.21    |
| 2   | 53.3969           | 4130                     | 0348                                    | 39.99     |     |                   |                          |   |           |

Weighted mean..... +43.60  
 $V_a$ ..... -17.17  
 $V_d$ ..... +.05  
 Curvature..... .28  
 Radial velocity..... +26.2

$\beta$  ORIONIS 2161.

1909, Jan. 18.  
G. M. T. 12<sup>h</sup> 41<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.7073           |                          |   |           | 2   | 53.0908           |                          |   |           |
| 2   | 53.9976           |                          |   |           | 2   | 45.2916           |                          |   |           |
| 2   | 53.9851           | 9880                     | 0448                                    | +51.81    | 2½  | 45.3141           | 3160                     | 0571                                    | +59.96    |
| 1½  | 53.4217           | 4220                     | 0438                                    | 50.37     |     |                   |                          |   |           |

Weighted mean..... +54.84  
 $V_a$ ..... -17.17  
 $V_d$ ..... +.05  
 Curvature..... .28  
 Radial velocity..... +37.1

$\gamma$  ORIONIS 2162.

1909. Jan. 18.  
G. M. T. 12<sup>h</sup> 46<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54.7174           |                          |                            |           | 2   | 53.0979           |                          |                            |           |
| 2   | 54.0111           |                          |                            |           | 2   | 45.3097           |                          |                            |           |
| 3   | 53.9987           | .9900                    | .0468                      | -54.12    | 2   | 45.2267           | .3105                    | .0516                      | +54.19    |
| 2   | 53.4185           | .4098                    | .0316                      | 36.34     |     |                   |                          |                            |           |

Weighted mean ..... +49.06  
 $V_a$  ..... -17.17  
 $V_d$  ..... + .05  
 Curvature ..... - .28  
 Radial velocity ..... +31.3

$\beta$  ORIONIS 2163.

1909. Jan. 18.  
G. M. T. 12<sup>h</sup> 51<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54.7067           |                          |                            |           | 2   | 53.0858           |                          |                            |           |
| 2   | 53.9965           |                          |                            |           | 2   | 45.2994           |                          |                            |           |
| 3   | 53.9771           | .9820                    | .0388                      | +44.87    | 2   | 45.3122           | .3064                    | .0475                      | +49.88    |
| 1   | 53.4107           | .4147                    | .0365                      | 41.94     |     |                   |                          |                            |           |

Weighted mean ..... +46.05  
 $V_a$  ..... -17.51  
 $V_d$  ..... + .08  
 Curvature ..... - .28  
 Radial velocity ..... +28.3

$\beta$  ORIONIS 2164.

1909. Jan. 18.  
G. M. T. 13<sup>h</sup> 06<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54.7077           |                          |                            |           | 2   | 53.0867           |                          |                            |           |
| 2   | 53.9990           |                          |                            |           | 2   | 45.2983           |                          |                            |           |
| 2   | 53.9926           | .9954                    | .0521                      | -59.16    | 3   | 45.3107           | .3060                    | .0471                      | +49.46    |
| 2   | 53.4235           | .4261                    | .0479                      | 51.04     |     |                   |                          |                            |           |

Weighted mean ..... +53.54  
 $V_a$  ..... -17.57  
 $V_d$  ..... + .08  
 Curvature ..... - .28  
 Radial velocity ..... +35.8



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$\beta$  ORIONIS 2165.

1909. Jan. 18.  
G. M. T. 13<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7128           |                          |  |           | 2   | 53.0967           |                          |  |           |
| 2   | 54.0073           |                          |  |           | 2   | 45.3114           |                          |  |           |
| 3   | 53.9885           | .9830                    | .0398                                  | +45.93    | 2   | 45.3277           | .3100                    | .0571                                  | +53.66    |
| 1   | 53.4284           | .4215                    | .0433                                  | 48.66     |     |                   |                          |  |           |

Weighted mean . . . . . +48.96  
 $V_a$  . . . . . 17.57  
 $V_d$  . . . . . .08  
 Curvature . . . . . .28  
 Radial velocity . . . . . +31.2

$\beta$  ORIONIS 2166.

1909. Jan. 18.  
G. M. T. 13<sup>h</sup> 14<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54.7106           |                          |  |           | 2   | 53.0896           |                          |  |           |
| 2               | 53.9998           |                          |  |           | 2   | 45.3060           |                          |  |           |
| 1 $\frac{1}{2}$ | 53.9796           | .9805                    | .0373                                  | +43.14    | 3   | 45.3184           | .3065                    | .0471                                  | +49.46    |
| 1 $\frac{1}{2}$ | 53.4221           | .4225                    | .0443                                  | 50.95     |     |                   |                          |  |           |

Weighted mean . . . . . +48.25  
 $V_a$  . . . . . -17.57  
 $V_d$  . . . . . +.08  
 Curvature . . . . . .28  
 Radial velocity . . . . . +30.5

$\beta$  ORIONIS 2177.

1909. Jan. 26.  
G. M. T. 10<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7218           |                          |  |           | 2   | 53.0968           |                          |  |           |
| 2   | 54.0098           |                          |  |           | 2   | 45.2904           |                          |  |           |
| 2   | 53.9936           | .9856                    | .0124                                  | +49.04    | 2   | 45.2922           | .2954                    | .0365                                  | +38.33    |
| 1   | 53.4276           | .4200                    | .0418                                  | 48.03     |     |                   |                          |  |           |

Weighted mean . . . . . +44.55  
 $V_a$  . . . . . -19.95  
 $V_d$  . . . . . +.22  
 Curvature . . . . . .28  
 Radial velocity . . . . . +24.6

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1909. Jan. 26.  
G. M. T. 10<sup>h</sup> 51<sup>m</sup>

$\beta$  ORIONIS 2178.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54 7527           |                          |                            |           | 2   | 53 1294           |                          |                            |           |
| 2   | 54 0433           |                          |                            |           | 2   | 45 3207           |                          |                            |           |
| 3   | 54 0181           | 9766                     | 0334                       | +38 63    | 1   | 45 3132           | 2861                     | 0272                       | +28 56    |
| 1½  | 52 4554           | 4150                     | 0368                       | 42 29     |     |                   |                          |                            |           |

Weighted mean ..... +37 80  
 $V_a$  ..... -19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... +17 8

1909. Jan. 26.  
G. M. T. 10<sup>h</sup> 56<sup>m</sup>

$\beta$  ORIONIS 2179.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54 7468           |                          |                            |           | 2   | 53 1221           |                          |                            |           |
| 2   | 54 0423           |                          |                            |           | 2   | 45 3160           |                          |                            |           |
| 2   | 54 0140           | 53 9780                  | 0348                       | +40 25    | 2   | 45 3215           | 2990                     | 0401                       | +42 11    |
| 1½  | 53 4594           | 4260                     | 0478                       | 54 93     |     |                   |                          |                            |           |

Weighted mean ..... +44 93  
 $V_a$  ..... -19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... +24 9

1909. Jan. 26.  
G. M. T. 11<sup>h</sup> 01<sup>m</sup>

$\beta$  ORIONIS 2180.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 54 7250           |                          |                            |           | 2   | 53 1036           |                          |                            |           |
| 2   | 54 0212           |                          |                            |           | 2   | 45 2950           |                          |                            |           |
| 2½  | 53 9934           | 9770                     | 0338                       | +59 09    | 1½  | 45 3008           | 2994                     | 0405                       | +42 53    |
| 1   | 53 4420           | 4270                     | 0488                       | 56 08     |     |                   |                          |                            |           |

Weighted mean ..... +43 52  
 $V_a$  ..... -19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... +23 5

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1909, Jan. 26,  
G. M. T. 11<sup>h</sup> 11<sup>m</sup>

ORIONIS 2181.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7250           |                          |  |           | 2   | 53 0986           |                          |  |           |
| 2   | 54 0155           |                          |  |           | 2   | 45 2998           |                          |  |           |
| 3   | 53 9908           | 9780                     | 0358                                     | +41 40    | 1½  | 45 3051           | 2990                     | 0401                                     | +42 11    |
| 1   | 53 4287           | 4180                     | 0398                                     | 45 73     |     |                   |                          |  |           |

Weighted mean ..... - 42 38  
 $V_a$  ..... - 19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... - 22 4

1909, Jan. 26,  
G. M. T. 11<sup>h</sup> 16<sup>m</sup>

ORIONIS 2182.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7440           |                          |  |           | 2   | 53 1178           |                          |  |           |
| 2   | 54 0407           |                          |  |           | 2   | 45 3090           |                          |  |           |
| 2   | 54 0083           | 9770                     | 0338                                     | +39 09    | 2   | 45 3066           | 2912                     | 0323                                     | +33 92    |
| ½   | 53 4372           | 4080                     | 0298                                     | 34 24     |     |                   |                          |  |           |

Weighted mean ..... +36 25  
 $V_a$  ..... - 19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... - 16 2

1909, Jan. 26,  
G. M. T. 11<sup>h</sup> 21<sup>m</sup>

ORIONIS 2183.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7394           |                          |  |           | 2   | 53 1107           |                          |  |           |
| 2   | 54 0262           |                          |  |           | 2   | 45 2972           |                          |  |           |
| 3   | 54 0003           | 9760                     | 0328                                     | +37 93    | 2   | 45 3035           | 3000                     | 0411                                     | +43 16    |
| ½   | 53 4399           | 4175                     | 0393                                     | 45 14     |     |                   |                          |  |           |

Weighted mean ..... +40 49  
 $V_a$  ..... - 19 95  
 $V_d$  ..... + 22  
 Curvature ..... - 28  
 Radial velocity ..... - 20 5

1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 21<sup>m</sup>

$\beta$  ORIONIS 2184.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.7322           |                          |   |           | 2   | 53.1120           |                          |   |           |
| 2   | 54.0224           |                          |   |           | 2   | 45.3111           |                          |   |           |
| 3   | 54.0007           | .9800                    | .0368                                   | +42.56    | 2   | 45.3122           | .2947                    | .0358                                   | +37.59    |
| 1   | 53.4160           | .3940                    | .0158                                   | 18.16     |     |                   |                          |   |           |

Weighted mean..... +36.84  
 $V_a$ ..... -20.51  
 $V_d$ ..... +.21  
 Curvature..... -.28  
 Radial velocity..... -16.3

$\beta$  ORIONIS 2185.

1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 25<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.7073           |                          |   |           | 2   | 53.0869           |                          |   |           |
| 2   | 53.9993           |                          |   |           | 2   | 45.2864           |                          |   |           |
| 2   | 53.9800           | .9830                    | .0398                                   | +46.03    | 2   | 45.2882           | .2954                    | .0365                                   | +38.33    |
| 1   | 53.4194           | .4220                    | .0438                                   | 50.33     |     |                   |                          |   |           |

Weighted mean..... +43.81  
 $V_a$ ..... -20.51  
 $V_d$ ..... +.21  
 Curvature..... -.29  
 Radial velocity..... -23.2

$\beta$  ORIONIS 2186.

1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 29<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.7073           |                          |   |           | 2   | 53.0851           |                          |   |           |
| 2   | 54.0002           |                          |   |           | 2   | 45.2893           |                          |   |           |
| 2   | 53.9697           | .9735                    | .0303                                   | +35.04    | 2   | 45.2888           | .2930                    | .0341                                   | +35.81    |
| 1   | 53.4020           | .4060                    | .0278                                   | 31.94     |     |                   |                          |   |           |

Weighted mean..... +34.73  
 $V_a$ ..... -20.51  
 $V_d$ ..... +.21  
 Curvature..... -.28  
 Radial velocity..... +14.2

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1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 41<sup>m</sup>

$\beta$  ORIONIS 2187.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7131           |                          |  |           | 2   | 53.6944           |                          |  |           |
| 2   | 54.0015           |                          |  |           | 2   | 45.2911           |                          |  |           |
| 2   | 53.9731           | 9705                     | 0273                                   | +31.57    | 2   | 45.2883           | 2908                     | 0318                                   | +33.39    |
| 1½  | 53.4183           | 4140                     | 0358                                   | 41.14     |     |                   |                          |  |           |

Weighted mean..... +31.84  
 $V_a$ ..... -20.51  
 $V_d$ ..... + 21  
 Curvature..... - 28  
 Radial velocity..... +14.3

1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 44<sup>m</sup>

$\beta$  ORIONIS 2188.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7128           |                          |  |           | 2   | 53.0905           |                          |  |           |
| 2   | 54.0033           |                          |  |           | 2   | 45.2924           |                          |  |           |
| 2   | 53.9628           | 9614                     | 0182                                   | +21.05    | 1½  | 45.2857           | 2869                     | 0280                                   | +29.40    |
| 1½  | 53.4200           | 4187                     | 0405                                   | 46.54     |     |                   |                          |  |           |

Weighted mean..... +31.20  
 $V_a$ ..... -20.51  
 $V_d$ ..... + 21  
 Curvature..... - 28  
 Radial velocity..... +10.6

1909. Jan. 28.  
G. M. T. 11<sup>h</sup> 47<sup>m</sup>

$\beta$  ORIONIS 2189.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7175           |                          |  |           | 2   | 53.1003           |                          |  |           |
| 2   | 54.0085           |                          |  |           | 2   | 45.2987           |                          |  |           |
| 2   | 53.9802           | 9730                     | 0298                                   | +34.46    | 1½  | 45.2937           | 2886                     | 0397                                   | +41.69    |
| 1½  | 53.4243           | 4150                     | 0368                                   | 42.29     |     |                   |                          |  |           |

Weighted mean..... +38.98  
 $V_a$ ..... -20.51  
 $V_d$ ..... + 21  
 Curvature..... - 28  
 Radial velocity..... +18.4

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1909, Jan. 29,  
G. M. T. 12<sup>h</sup> 53<sup>m</sup>.

3 ORIONIS 2195.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity             | Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity.            |
|-----|------------------------------------|--------------------------|---|----------------------|-----|------------------------------------|--------------------------|---|----------------------|
| 2   | 54 <sup>h</sup> 52 <sup>m</sup> 12 |                          |   |                      | 2   | 53 <sup>h</sup> 10 <sup>m</sup> 14 |                          |   |                      |
| 2   | 54 <sup>h</sup> 01 <sup>m</sup> 76 |                          |   |                      | 2   | 45 <sup>h</sup> 29 <sup>m</sup> 06 |                          |   |                      |
| 2   | 53 <sup>h</sup> 98 <sup>m</sup> 40 | 9710                     | 0278                                    | - 32 <sup>h</sup> 15 | 1   | 45 <sup>h</sup> 29 <sup>m</sup> 28 | 2958                     | 0369                                    | - 38 <sup>h</sup> 75 |
| 1   | 53 <sup>h</sup> 42 <sup>m</sup> 61 | 4135                     | 0353                                    | 40 <sup>h</sup> 56   |     |                                    |                          |   |                      |

Weighted mean..... +35<sup>h</sup> 90  
 $V_a$ ..... - 20<sup>h</sup> 79  
 $V_d$ ..... + 05  
 Curvature..... - 28  
 Radial velocity..... +14<sup>h</sup> 9

3 ORIONIS 2196.

1909, Jan. 29,  
G. M. T. 12<sup>h</sup> 57<sup>m</sup>.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity.            | Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity.            |
|-----|------------------------------------|--------------------------|---|----------------------|-----|------------------------------------|--------------------------|---|----------------------|
| 2   | 54 <sup>h</sup> 71 <sup>m</sup> 68 |                          |   |                      | 2   | 53 <sup>h</sup> 09 <sup>m</sup> 46 |                          |   |                      |
| 2   | 54 <sup>h</sup> 00 <sup>m</sup> 73 |                          |   |                      | 2   | 45 <sup>h</sup> 28 <sup>m</sup> 94 |                          |   |                      |
| 3   | 53 <sup>h</sup> 98 <sup>m</sup> 17 | 9762                     | 0330                                    | + 38 <sup>h</sup> 16 | 1½  | 45 <sup>h</sup> 28 <sup>m</sup> 77 | 2919                     | 0330                                    | + 34 <sup>h</sup> 65 |
| ½   | 53 <sup>h</sup> 43 <sup>m</sup> 24 | 4270                     | 0488                                    | 56 <sup>h</sup> 08   |     |                                    |                          |   |                      |

Weighted mean..... +38<sup>h</sup> 90  
 $V_a$ ..... - 20<sup>h</sup> 79  
 $V_d$ ..... + 05  
 Curvature..... - 28  
 Radial velocity..... +17<sup>h</sup> 9

3 ORIONIS 2197.

1909, Jan. 29,  
G. M. T. 13<sup>h</sup> 01<sup>m</sup>.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity.            | Wt. | Mean of Settings.                  | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity.            |
|-----|------------------------------------|--------------------------|---|----------------------|-----|------------------------------------|--------------------------|---|----------------------|
| 2   | 54 <sup>h</sup> 72 <sup>m</sup> 22 |                          |   |                      | 2   | 53 <sup>h</sup> 09 <sup>m</sup> 81 |                          |   |                      |
| 2   | 54 <sup>h</sup> 00 <sup>m</sup> 97 |                          |   |                      | 2   | 45 <sup>h</sup> 29 <sup>m</sup> 19 |                          |   |                      |
| 2   | 53 <sup>h</sup> 98 <sup>m</sup> 81 | 9790                     | 0358                                    | + 41 <sup>h</sup> 40 | 1   | 45 <sup>h</sup> 30 <sup>m</sup> 34 | 3050                     | 0461                                    | + 48 <sup>h</sup> 41 |
| ½   | 53 <sup>h</sup> 44 <sup>m</sup> 80 | 4390                     | 0608                                    | 69 <sup>h</sup> 87   |     |                                    |                          |   |                      |

Weighted mean..... +47<sup>h</sup> 47  
 $V_a$ ..... - 20<sup>h</sup> 79  
 $V_d$ ..... + 05  
 Curvature..... - 28  
 Radial velocity..... +26<sup>h</sup> 4

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$\beta$  ORIONIS 2198.

1909. Jan. 29.  
G. M. T. 13<sup>h</sup> 05<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7170           |                          |  |           | 2   | 53.0924           |                          |  |           |
| 2   | 54.0100           |                          |  |           | 2   | 45.2871           |                          |  |           |
| 2   | 53.9896           | 9840                     | 0.108                                    | 47.18     | 2   | 45.2927           | 2992                     | 0.403                                    | -42.32    |
| 1½  | 53.4164           | 4120                     | 0.338                                    | 38.84     |     |                   |                          |  |           |

Weighted mean ..... + 43.14  
 $V_a$  ..... 20.79  
 $V_d$  ..... 05  
 Curvature ..... 28  
 Radial velocity ..... + 22.1

$\beta$  ORIONIS 2201.

1909. Jan. 30.  
G. M. T. 12<sup>h</sup> 29<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7150           |                          |  |           | 2   | 53.0957           |                          |  |           |
| 2   | 54.0093           |                          |  |           | 2   | 45.2906           |                          |  |           |
| 3   | 53.9791           | 9730                     | 0.298                                    | +34.46    | 2   | 45.2884           | 2914                     | 0.325                                    | +34.13    |
| 1   | 53.4193           | 4130                     | 0.348                                    | 39.99     |     |                   |                          |  |           |

Weighted mean ..... + 35.27  
 $V_a$  ..... 21.05  
 $V_d$  ..... + 06  
 Curvature ..... 28  
 Radial velocity ..... + 14.0

$\beta$  ORIONIS 2202.

1909. Jan. 30.  
G. M. T. 12<sup>h</sup> 41<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7150           |                          |  |           | 2   | 53.5937           |                          |  |           |
| 2   | 54.0022           |                          |  |           | 2   | 45.2878           |                          |  |           |
| 1½  | 53.9764           | 9710                     | 0.268                                    | +30.99    | 2   | 45.2963           | 3020                     | 0.431                                    | +45.26    |
| 1   | 53.4141           | 4100                     | 0.318                                    | 36.54     |     |                   |                          |  |           |

Weighted mean ..... + 38.57  
 $V_a$  ..... 21.05  
 $V_d$  ..... + 06  
 Curvature ..... 28  
 Radial velocity ..... + 17.3

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1909. Jan. 30.  
G. M. T. 12<sup>h</sup> 45<sup>m</sup> $\beta$  ORIONIS 2203.Observed by } J. S. PLASKETT.  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|---------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2             | 54.7115           |                          |  |           | 2   | 53.0902           |                          |  |           |
| 2             | 53.9970           |                          |  |           | 2   | 45.2808           |                          |  |           |
| 1             | 53.9941           | .9950                    | .0518                                  | +59.91    | 2   | 45.2822           | .2950                    | .0361                                  | +37.91    |
| $\frac{1}{2}$ | 53.4224           | .4240                    | .0458                                  | 52.63     |     |                   |                          |  |           |

Weighted mean..... +46.29  
 $V_a$ ..... -21.05  
 $V_d$ ..... +.06  
 Curvature..... -.28

Radial velocity..... +25.0

1909. Jan. 30.  
G. M. T. 12<sup>h</sup> 48<sup>m</sup> $\beta$  ORIONIS 2204.Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7152           |                          |  |           | 2   | 53.0917           |                          |  |           |
| 2   | 54.0046           |                          |  |           | 2   | 45.2933           |                          |  |           |
| 1   | 53.9739           | .9712                    | .0280                                  | +33.38    | 2   | 45.2969           | .2972                    | .0383                                  | +40.22    |
| 1   | 53.4059           | .4034                    | .0252                                  | 28.96     |     |                   |                          |  |           |

Weighted mean..... +35.45  
 $V_a$ ..... -21.05  
 $V_d$ ..... +.06  
 Curvature..... -.28

Radial velocity..... +14.2

1909. Jan. 30.  
G. M. T. 15<sup>h</sup> 47<sup>m</sup> $\beta$  ORIONIS 2205.Observed by } J. S. PLASKETT.  
Measured by }

| Wt.            | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|----------------|-------------------|--------------------------|--|-----------|----------------|-------------------|--------------------------|--|-----------|
| 2              | 63.3385           |                          |  |           | 2              | 58.7894           |                          |  |           |
| 2              | 61.3585           |                          |  |           | 2              | 36.1737           |                          |  |           |
| 3              | 61.2878           | .2744                    | .0939                                  | +38.82    | $1\frac{1}{2}$ | 36.1979           | .2180                    | .1275                                  | +44.83    |
| $1\frac{1}{2}$ | 59.7215           | .7140                    | .1175                                  | 48.07     |                |                   |                          |  |           |

Weighted mean..... +42.63  
 $V_a$ ..... -21.05  
 $V_d$ ..... +.06  
 Curvature..... -.28

Radial velocity..... +21.0



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$\beta$  ORIONIS 2206.

1909, Jan. 30,  
G. M. T. 16<sup>h</sup> 01<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3436           |                          |   |           | 2   | 58.7994           |                          |   |           |
| 2   | 61.3644           |                          |   |           | 2   | 36.1900           |                          |   |           |
| 2   | 61.3040           | 2850                     | 1045                                      | +43.20    | 1½  | 36.2016           | 2088                     | 1173                                      | +41.24    |
| 1½  | 59.7313           | 7150                     | 1185                                      | 48.48     |     |                   |                          |   |           |

Weighted mean..... +44.20  
 $V_a$ ..... -21.10  
 $V_d$ ..... -24  
 Curvature..... -28  
 Radial velocity..... -22.6

$\beta$  ORIONIS 2207.

1909, Jan. 30,  
G. M. T. 16<sup>h</sup> 24<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3410           |                          |   |           | 2   | 58.7983           |                          |   |           |
| 2   | 61.3604           |                          |   |           | 2   | 36.1943           |                          |   |           |
| 3   | 61.3037           | 2880                     | 1075                                      | +44.44    | 2   | 36.2027           | 2026                     | 1121                                      | +39.41    |
| 1½  | 59.7308           | 7160                     | 1195                                      | 48.89     |     |                   |                          |   |           |

Weighted mean..... +43.92  
 $V_a$ ..... -21.10  
 $V_d$ ..... -24  
 Curvature..... -28  
 Radial velocity..... +22.3

$\beta$  ORIONIS 2211.

1909, Jan. 31,  
G. M. T. 17<sup>h</sup> 16<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54.7191           |                          |   |           | 2   | 53.0951           |                          |   |           |
| 2   | 54.0068           |                          |   |           | 2   | 45.2834           |                          |   |           |
| 2   | 53.9870           | 9800                     | 0368                                      | +42.56    | 2   | 45.2806           | 2908                     | 0319                                      | +33.50    |
| 1   | 53.4342           | 4275                     | 0493                                      | 56.65     |     |                   |                          |   |           |

Weighted mean..... +41.75  
 $V_a$ ..... -21.33  
 $V_d$ ..... -31  
 Curvature..... -28  
 Radial velocity..... -19.8

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$\beta$  ORIONIS 2212.

1909. Jan. 31.  
G. M. T. 17<sup>h</sup> 20<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7084           | .....                    | .....                                  | .....     | 2   | 53 0894           | .....                    | .....                                  | .....     |
| 2   | 54 0012           | .....                    | .....                                  | .....     | 2   | 45 2894           | .....                    | .....                                  | .....     |
| 2   | 53 9833           | 9835                     | 0403                                   | -46 61    | 1½  | 45 2886           | 2928                     | 0339                                   | -35 60    |
| 1   | 53 4274           | 4273                     | 0491                                   | 56 42     |     |                   |                          |  |           |

Weighted mean ..... +45 12  
 $V_a$  ..... -21 33  
 $V_d$  ..... - 31  
 Curvature ..... - 28  
 Radial velocity ..... +23 2

$\beta$  ORIONIS 2213.

1909. Jan. 31.  
G. M. T. 17<sup>h</sup> 24<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7118           | .....                    | .....                                  | .....     | 2   | 53 0904           | .....                    | .....                                  | .....     |
| 2   | 54 0115           | .....                    | .....                                  | .....     | 2   | 45 2938           | .....                    | .....                                  | .....     |
| 2   | 53 9797           | 9737                     | 0305                                   | +35 27    | 2   | 45 2925           | 2923                     | 0334                                   | +35 07    |
| 1   | 53 4258           | 4190                     | 0408                                   | 46 88     |     |                   |                          |  |           |

Weighted mean ..... +37 91  
 $V_a$  ..... -21 33  
 $V_d$  ..... - 31  
 Curvature ..... - 28  
 Radial velocity ..... +16 0

$\beta$  ORIONIS 2214.

1909. Jan. 31.  
G. M. T. 17<sup>h</sup> 29<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7065           | .....                    | .....                                  | .....     | 2   | 53 0873           | .....                    | .....                                  | .....     |
| 2   | 53 9988           | .....                    | .....                                  | .....     | 2   | 45 2835           | .....                    | .....                                  | .....     |
| 1½  | 53 9808           | 9840                     | 0408                                   | +47 18    | 2   | 45 2763           | 2864                     | 0275                                   | +28 88    |
| 1   | 53 4149           | 4174                     | 0392                                   | 45 04     |     |                   |                          |  |           |

Weighted mean ..... +38 57  
 $V_a$  ..... -21 33  
 $V_d$  ..... - 31  
 Curvature ..... - 28  
 Radial velocity ..... +16 6

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$\beta$  ORIONIS 2215.

1909, Feb. 2,  
G. M. T. 11<sup>h</sup> 14<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7098           |                          |  |           | 2   | 53 0885           |                          |  |           |
| 2   | 54 0038           |                          |  |           | 2   | 45 2951           |                          |  |           |
| 2   | 53 9791           | 9803                     | 0371                                   | 12 90     | 2   | 45 3072           | 3067                     | 0478                                   | 56 19     |
| 2   | 53 4182           | 4192                     | 0410                                   | 17 11     |     |                   |                          |  |           |

Weighted mean ..... +46 73  
 $V_a$  ..... -21 79  
 $V_d$  ..... + 14  
 Curvature ..... - 28  
 Radial velocity ..... +24 8

$\beta$  ORIONIS 2216.

1909, Feb. 2,  
G. M. T. 11<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7162           |                          |  |           | 2   | 53 0940           |                          |  |           |
| 2   | 54 0091           |                          |  |           | 2   | 45 3030           |                          |  |           |
| 3   | 53 9864           | 9810                     | 0378                                   | +43 72    | 2   | 45 3047           | 2953                     | 0364                                   | +38 22    |
| 2   | 53 4299           | 4250                     | 0468                                   | 53 78     |     |                   |                          |  |           |

Weighted mean ..... +45 02  
 $V_a$  ..... -21 79  
 $V_d$  ..... - 14  
 Curvature ..... - 28  
 Radial velocity ..... +23 1

$\beta$  ORIONIS 2217.

1909, Feb. 2,  
G. M. T. 11<sup>h</sup> 26<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7143           |                          |  |           | 2   | 53 0916           |                          |  |           |
| 1   | 54 0053           |                          |  |           | 2   | 45 2940           |                          |  |           |
| 3   | 53 9820           | 9790                     | 0358                                   | +41 40    | 2   | 45 3032           | 3028                     | 0439                                   | +46 10    |
| 1   | 53 4303           | 4277                     | 0495                                   | 56 88     |     |                   |                          |  |           |

Weighted mean ..... +45 35  
 $V_a$  ..... -21 79  
 $V_d$  ..... + 14  
 Curvature ..... - 28  
 Radial velocity ..... -23 6

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 $\beta$  ORIONIS 2218.1909. Feb. 2.  
G. M. T. 11<sup>h</sup> 29<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7101           | .....                    | .....                                  | .....     | 2   | 53 0910           | .....                    | .....                                  | .....     |
| 2   | 54 0023           | .....                    | .....                                  | .....     | 2   | 45 2961           | .....                    | .....                                  | .....     |
| 2   | 53 9848           | 9845                     | 0413                                   | +47.76    | 2   | 45 3020           | 2995                     | 0406                                   | +42.63    |
| 1   | 53 4172           | 4160                     | 0378                                   | 43.44     |     |                   |                          |  |           |

Weighted mean..... +44.44  
 $V_a$ ..... -21.97  
 $V_d$ ..... +.14  
 Curvature..... -.28

Radial velocity..... +22.5

 $\beta$  ORIONIS 2219.1909. Feb. 2.  
G. M. T. 11<sup>h</sup> 41<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 54 7180           | .....                    | .....                                  | .....     | 2   | 53 0937           | .....                    | .....                                  | .....     |
| 2               | 54 0106           | .....                    | .....                                  | .....     | 2   | 45 3002           | .....                    | .....                                  | .....     |
| 3               | 53 9813           | 9740                     | 0308                                   | +35.62    | 2   | 45 3032           | 2966                     | 0377                                   | +39.59    |
| 1 $\frac{1}{2}$ | 53 4213           | 4150                     | 0368                                   | 42.29     |     |                   |                          |  |           |

Weighted mean..... +38.39  
 $V_a$ ..... -21.79  
 $V_d$ ..... +.14  
 Curvature..... -.28

Radial velocity..... +16.5

 $\beta$  ORIONIS 2220.1909. Feb. 2.  
G. M. T. 11<sup>h</sup> 45<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7113           | .....                    | .....                                  | .....     | 2   | 53 0952           | .....                    | .....                                  | .....     |
| 2   | 54 0073           | .....                    | .....                                  | .....     | 2   | 45 2903           | .....                    | .....                                  | .....     |
| 3   | 53 9847           | 9800                     | 0368                                   | +42.56    | 2   | 45 2967           | 3000                     | 0411                                   | +43.16    |
| 1   | 53 4305           | 4250                     | 0468                                   | 53.78     |     |                   |                          |  |           |

Weighted mean..... +44.63  
 $V_a$ ..... -21.79  
 $V_d$ ..... +.14  
 Curvature..... -.28

Radial velocity..... +22.7

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$\beta$  ORIONIS 2220\*

1909, Feb. 2.  
G. M. T. 11<sup>h</sup> 45<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7580           |                          |  |           | 3   | 53.1366           |                          |  |           |
| 2   | 54.0249           | .9779                    | .0347                                  | +40.03    | 2   | 45.3355           | .3006                    | .0417                                  | +43.78    |
| 1½  | 53.4623           | .4151                    | .0369                                  | 42.40     | 3   | 45.3285           |                          |  |           |

Weighted mean ..... +42.04  
 $V_a$  ..... -21.79  
 $V_d$  ..... +.14  
 Curvature ..... -.28

\* Check.

Radial velocity ..... +20.2

$\beta$  ORIONIS 2236.

1909, Feb. 6.  
G. M. T. 12<sup>h</sup> 29<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 51.7129           |                          |  |           | 2   | 53.0895           |                          |  |           |
| 2   | 51.0040           |                          |  |           | 2   | 45.2921           |                          |  |           |
| 2   | 53.9767           | .9750                    | .0318                                  | +36.78    | 3   | 45.2985           | .3000                    | .0411                                  | -43.16    |
| 1   | 53.4149           | .4143                    | .0361                                  | 41.48     |     |                   |                          |  |           |

Weighted mean ..... +40.75  
 $V_a$  ..... -22.07  
 $V_d$  ..... -.24  
 Curvature ..... -.28

Radial velocity ..... +18.2

$\beta$  ORIONIS 2239.

1909, Feb. 6.  
G. M. T. 12<sup>h</sup> 50<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7144           |                          |  |           | 2   | 53.0925           |                          |  |           |
| 2   | 54.0085           |                          |  |           | 2   | 45.2967           |                          |  |           |
| 2   | 53.9843           | .9810                    | .0378                                  | -43.72    | 2   | 45.3043           | .3012                    | .0423                                  | -44.42    |
| 1½  | 53.4083           | .4052                    | .0270                                  | 31.03     |     |                   |                          |  |           |

Weighted mean ..... -42.62  
 $V_a$  ..... -22.07  
 $V_d$  ..... -.21  
 Curvature ..... -.28

Radial velocity ..... +20.0

$\gamma$  ORIONIS 2240.

1909, Feb. 6,  
G. M. T. 12<sup>m</sup> 52<sup>s</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7160           |                          |  |           | 2   | 53 0936           |                          |  |           |
| 2   | 54 0966           |                          |  |           | 2   | 45 2951           |                          |  |           |
| 2   | 53 9845           | 9800                     | 0368                                   | - 42 56   | 1   | 45 2950           | 2935                     | 0346                                   | - 36 33   |
| 2   | 53 4254           | 4210                     | 0428                                   | 49 18     |     |                   |                          |  |           |

Weighted mean ..... + 43 96  
 $V_a$  ..... - 22 07  
 $V_d$  ..... - 24  
 Curvature ..... - 28  
 Radial velocity ..... + 21 0

$\beta$  ORIONIS 2241.

1909, Feb. 6,  
G. M. T. 16<sup>m</sup> 12<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3172           |                          |  |           | 2   | 58 7726           |                          |  |           |
| 2   | 61 3357           |                          |  |           | 2   | 36 1652           |                          |  |           |
| 2   | 61 2768           | 2858                     | 1053                                   | + 43 53   | 1½  | 36 1710           | 2000                     | 1095                                   | + 38 00   |
| 1½  | 59 7176           | 7280                     | 1315                                   | 54 10     |     |                   |                          |  |           |

Weighted mean ..... + 45 19  
 $V_a$  ..... - 22 73  
 $V_d$  ..... - 30  
 Curvature ..... - 28  
 Radial velocity ..... + 21 9

$\beta$  ORIONIS 2242.

1909, Feb. 6,  
G. M. T. 16<sup>m</sup> 43<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3249           |                          |  |           | 2   | 58 7845           |                          |  |           |
| 2   | 61 3494           |                          |  |           | 2   | 36 1810           |                          |  |           |
| 2   | 61 2686           | 2670                     | 0865                                   | + 35 76   | 1½  | 36 1972           | 2104                     | 1199                                   | + 42 16   |
| 1½  | 59 7224           | 7220                     | 1255                                   | 51 34     |     |                   |                          |  |           |

Weighted mean ..... + 42 36  
 $V_a$  ..... - 22 73  
 $V_d$  ..... - 30  
 Curvature ..... - 28  
 Radial velocity ..... + 19 1

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$\beta$  ORIONIS 2243.

1909, Feb. 7,  
G. M. T. 15<sup>h</sup> 11<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63.3350           |                          |                            |           | 2   | 58.7918           |                          |                            |           |
| 2   | 61.3619           |                          |                            |           | 2   | 36.1731           |                          |                            |           |
| 2   | 61.2972           | 2852                     | 1065                       | +44.03    | 2   | 36.1874           | 2085                     | 1180                       | +41.74    |
| 1½  | 59.7234           | 7150                     | 1185                       | 48.48     |     |                   |                          |                            |           |

Weighted mean..... +44.42  
 $V_a$ ..... -22.93  
 $V_d$ ..... -23  
 Curvature..... -28  
 Radial velocity..... -21.0

$\beta$  ORIONIS 2244.

1909, Feb. 7,  
G. M. T. 15<sup>h</sup> 25<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63.3380           |                          |                            |           | 2   | 58.7900           |                          |                            |           |
| 2   | 61.3554           |                          |                            |           | 2   | 36.1752           |                          |                            |           |
| 2   | 61.2952           | 2855                     | 1060                       | +43.41    | 1½  | 36.1830           | 2020                     | 1115                       | +39.20    |
| 1   | 59.7458           | 7388                     | 1423                       | 58.21     |     |                   |                          |                            |           |

Weighted mean..... +45.30  
 $V_a$ ..... -22.93  
 $V_d$ ..... -23  
 Curvature..... -28  
 Radial velocity..... +21.9

$\beta$  ORIONIS 2245.

1909, Feb. 7,  
G. M. T. 15<sup>h</sup> 37<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63.3424           |                          |                            |           | 2   | 58.7988           |                          |                            |           |
| 2   | 61.3620           |                          |                            |           | 2   | 36.1867           |                          |                            |           |
| 1½  | 61.2862           | 2692                     | 0887                       | +35.97    | 1   | 36.1858           | 1963                     | 1058                       | +37.20    |
| 1   | 59.7488           | 7338                     | 1373                       | 56.05     |     |                   |                          |                            |           |

Weighted mean..... +41.45  
 $V_a$ ..... -22.93  
 $V_d$ ..... -23  
 Curvature..... -28  
 Radial velocity..... +18.0

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 $\beta$  ORIONIS 2249.1909. Feb. 8.  
G. M. T. 13<sup>h</sup> 32<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7050           |                          |  |           | 2   | 53 0824           |                          |  |           |
| 2   | 53 9998           |                          |  |           | 2   | 45 2868           |                          |  |           |
| 3   | 53 9795           | 9845                     | 0413                                   | -47 76    | 2   | 45 3024           | 3092                     | 0503                                   | -52 82    |
| 2   | 53 4276           | 4375                     | 0593                                   | 68 14     |     |                   |                          |  |           |

Weighted mean..... + 55 03  
 $V_a$ ..... - 23 11  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... + 31 6

 $\beta$  ORIONIS 2250.1909. Feb. 8.  
G. M. T. 13<sup>h</sup> 36<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 6972           |                          |  |           | 2   | 53 0777           |                          |  |           |
| 2   | 53 9910           |                          |  |           | 2   | 45 2869           |                          |  |           |
| 2   | 53 9713           | 9835                     | 0403                                   | -46 61    | 1½  | 45 2950           | 3027                     | 0438                                   | +45 99    |
| 1   | 53 4184           | 4304                     | 0522                                   | 59 98     |     |                   |                          |  |           |

Weighted mean..... + 49 37  
 $V_a$ ..... - 23 11  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... + 25 9

 $\beta$  ORIONIS 2251.1909. Feb. 8.  
G. M. T. 13<sup>h</sup> 41<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7049           |                          |  |           | 2   | 53 0838           |                          |  |           |
| 2   | 53 9982           |                          |  |           | 2   | 45 2878           |                          |  |           |
| 2   | 53 9698           | 9755                     | 0323                                   | -37 35    | 1½  | 45 2914           | 2972                     | 0383                                   | +40 22    |
| 3   | 53 4168           | 4225                     | 0443                                   | 50 91     |     |                   |                          |  |           |

Weighted mean..... + 44 27  
 $V_a$ ..... - 23 11  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... + 21 8



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$\beta$  ORIONIS 2252.

1909, Feb. 8,  
G. M. T. 14<sup>h</sup> 01<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7056           |                          |  |           | 2   | 53 0882           |                          |  |           |
| 2   | 53 9980           |                          |  |           | 2   | 45 2060           |                          |  |           |
| 1½  | 53 9779           | 9815                     | 0383                                   | - 44 29   | 1½  | 45 2982           | 2958                     | 0369                                   | + 38 75   |
| ½   | 53 4076           | 4095                     | 0313                                   | 35 97     |     |                   |                          |  |           |

Weighted mean ..... +41.05  
*V<sub>a</sub>* ..... - 23.11  
*V<sub>d</sub>* ..... - .08  
 Curvature ..... .28

Radial velocity ..... +17.6

$\beta$  ORIONIS 2253.

1909, Feb. 8,  
G. M. T. 14<sup>h</sup> 05<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7217           |                          |  |           | 2   | 53 1030           |                          |  |           |
| 2   | 54 0110           |                          |  |           | 2   | 45 3090           |                          |  |           |
| 2   | 53 9862           | 9762                     | 0330                                   | - 38 16   | 2   | 45 3240           | 3086                     | 0497                                   | + 52 19   |
| 3   | 53 4354           | 4230                     | 0448                                   | 51 48     |     |                   |                          |  |           |

Weighted mean ..... +47.88  
*V<sub>a</sub>* ..... - 23.11  
*V<sub>d</sub>* ..... - .08  
 Curvature ..... .28

Radial velocity ..... +24.1

$\beta$  ORIONIS 2254.

1909, Feb. 8,  
G. M. T. 14<sup>h</sup> 09<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7152           |                          |  |           | 2   | 53 0993           |                          |  |           |
| 2   | 54 0084           |                          |  |           | 2   | 45 3112           |                          |  |           |
| 2   | 53 9930           | 9860                     | 0428                                   | - 49 50   | 2   | 45 3142           | 2966                     | 0377                                   | + 39 59   |
| 1   | 53 4357           | 4265                     | 0483                                   | 55 50     |     |                   |                          |  |           |

Weighted mean ..... +46.74  
*V<sub>a</sub>* ..... - 23.11  
*V<sub>d</sub>* ..... - .08  
 Curvature ..... .28

Radial velocity ..... - 23.3

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 $\beta$  ORIONIS 2265.1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 07<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 6987           | .....                    | .....                                  | .....     | 2   | 53 0767           | .....                    | .....                                  | .....     |
| 2   | 53 9911           | .....                    | .....                                  | .....     | 2   | 45 2770           | .....                    | .....                                  | .....     |
| 2   | 53 9691           | 9800                     | 0368                                   | -42 56    | 2   | 45 2980           | 3146                     | 0557                                   | +58 49    |
| 1½  | 53 4197           | 4310                     | 0528                                   | 6 67      |     |                   |                          |  |           |

Weighted mean ..... +53 29  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28

Radial velocity ..... +29 6

 $\beta$  ORIONIS 2266.1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 12<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7090           | .....                    | .....                                  | .....     | 2   | 53 0932           | .....                    | .....                                  | .....     |
| 2   | 54 0052           | .....                    | .....                                  | .....     | 2   | 45 2916           | .....                    | .....                                  | .....     |
| 2   | 53 9815           | 9780                     | 0348                                   | +40 25    | 2   | 45 2989           | 3009                     | 0420                                   | +44 10    |
| 2   | 53 4312           | 4275                     | 0493                                   | 56 65     |     |                   |                          |  |           |

Weighted mean ..... +47 00  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28

Radial velocity ..... +23 3

 $\beta$  ORIONIS 2267.1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 16<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7055           | .....                    | .....                                  | .....     | 2   | 53 0868           | .....                    | .....                                  | .....     |
| 2   | 53 9982           | .....                    | .....                                  | .....     | 2   | 45 2923           | .....                    | .....                                  | .....     |
| 2   | 53 9744           | 9780                     | 0348                                   | +40 25    | 2   | 45 2994           | 3007                     | 0418                                   | +43 89    |
| 1½  | 53 4070           | 4100                     | 0318                                   | 36 54     |     |                   |                          |  |           |

Weighted mean ..... +40 56  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28

Radial velocity ..... +16 9

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$\beta$  ORIONIS 2268.

1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 21<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7108           |                          |  |           | 2   | 53 0920           |                          |  |           |
| 2   | 54 0029           |                          |  |           | 2   | 45 2948           |                          |  |           |
| 2   | 53 9702           | 9830                     | 0258                                   | +29 84    | 2   | 45 2962           | 2950                     | 0361                                   | +37 91    |
| 1/2 | 53 4186           | 4160                     | 0378                                   | 43 41     |     |                   |                          |  |           |

Weighted mean ..... +36 48  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28  
 Radial velocity ..... +12 8

$\beta$  ORIONIS 2269.

1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 33<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7094           |                          |  |           | 2   | 53 0894           |                          |  |           |
| 2   | 53 9959           |                          |  |           | 2   | 45 2919           |                          |  |           |
| 3   | 53 9814           | 9830                     | 0398                                   | +46 03    | 2   | 45 2979           | 2996                     | 0107                                   | +42 74    |
| 2   | 53 4142           | 4145                     | 0363                                   | 41 71     |     |                   |                          |  |           |

Weighted mean ..... +44 00  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28  
 Radial velocity ..... +20 3

$\beta$  ORIONIS 2270.

1909. Feb. 10.  
G. M. T. 12<sup>h</sup> 37<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54 7124           |                          |  |           | 2   | 53 0940           |                          |  |           |
| 2   | 54 0066           |                          |  |           | 2   | 45 2995           |                          |  |           |
| 2   | 53 9901           | 9870                     | 0438                                   | +49 50    | 2   | 45 3078           | 3019                     | 0430                                   | +45 15    |
| 1   | 53 4211           | 4167                     | 0385                                   | 44 24     |     |                   |                          |  |           |

Weighted mean ..... +46 71  
 $V_a$  ..... -23 48  
 $V_d$  ..... + 05  
 Curvature ..... - 28  
 Radial velocity ..... +23 0

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 26<sup>m</sup>

$\beta$  ORIONIS 2272.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54 7167           |                          |   |           | 2   | 53 0917           |                          |   |           |
| 2   | 54 0032           |                          |   |           | 2   | 45 2881           |                          |   |           |
| 2   | 53 9806           | 9785                     | 0353                                    | +40 82    | 2   | 45 2997           | 3052                     | 0463                                    | +48 62    |
| 1½  | 53 4114           | 4092                     | 0310                                    | 35 62     |     |                   |                          |   |           |

Weighted mean..... 42 78  
 $V_a$ ..... 23 65  
 $V_d$ ..... 10  
 Curvature..... 28  
 Radial velocity..... 18 9

$\beta$  ORIONIS 2273.

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 32<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54 7138           |                          |   |           | 2   | 53 0875           |                          |   |           |
| 2   | 54 0025           |                          |   |           | 2   | 45 2844           |                          |   |           |
| 2   | 53 9970           | 9060                     | 0528                                    | +61 06    | 2   | 45 3006           | 3098                     | 0509                                    | +53 45    |
| 1   | 53 4268           | 4280                     | 0498                                    | 57 23     |     |                   |                          |   |           |

Weighted mean..... + 57 25  
 $V_a$ ..... 23 65  
 $V_d$ ..... 10  
 Curvature..... 28  
 Radial velocity..... 33 4

$\beta$  ORIONIS 2274.

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 35<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 54 7114           |                          |   |           | 2   | 53 0881           |                          |   |           |
| 2   | 54 0044           |                          |   |           | 2   | 45 2877           |                          |   |           |
| 2   | 53 9812           | 9810                     | 0378                                    | +43 72    | 2   | 45 3071           | 3130                     | 0540                                    | +56 81    |
| 1½  | 53 4353           | 4360                     | 0378                                    | 66 42     |     |                   |                          |   |           |

Weighted mean..... + 43 72  
 $V_a$ ..... 23 65  
 $V_d$ ..... 10  
 Curvature..... 28  
 Radial velocity..... +30 8

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$\beta$  ORIONIS 2275.

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 38<sup>m</sup>

Observed by J. J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7133           |                          |  |           | 2   | 53.0921           |                          |  |           |
| 2   | 54.0063           |                          |  |           | 2   | 45.2911           |                          |  |           |
| 3   | 53.9782           | 0760                     | 0328                                   | -36.78    | 2   | 45.2979           | 3024                     | 0435                                   | -45.68    |
| 2   | 53.4256           | 4230                     | 0448                                   | -51.48    |     |                   |                          |  |           |

Weighted mean ..... -43.52  
 $V_a$  ..... 23.65  
 $V_d$  ..... -10  
 Curvature ..... 28  
 Radial velocity ..... -19.7

$\beta$  ORIONIS 2275.

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 46<sup>m</sup>

Observed by J. J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7082           |                          |  |           | 2   | 53.0893           |                          |  |           |
| 2   | 53.9963           |                          |  |           | 2   | 45.2824           |                          |  |           |
| 2   | 53.9792           | 0840                     | 0408                                   | -47.19    | 2   | 45.2835           | 2947                     | 0358                                   | -37.59    |
| 1   | 53.4083           | 4095                     | 0313                                   | -35.97    |     |                   |                          |  |           |

Weighted mean ..... -41.11  
 $V_a$  ..... 23.65  
 $V_d$  ..... -10  
 Curvature ..... 28  
 Radial velocity ..... -17.3

$\beta$  ORIONIS 2277.

1909. Feb. 11.  
G. M. T. 11<sup>h</sup> 49<sup>m</sup>

Observed by J. J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 54.7099           |                          |  |           | 2   | 53.0878           |                          |  |           |
| 2   | 54.0019           |                          |  |           | 2   | 45.2944           |                          |  |           |
| 2   | 53.9798           | 0810                     | 0378                                   | +43.72    | 1½  | 45.3021           | 3013                     | 0124                                   | +44.52    |
| 1   | 53.4279           | 4294                     | 0512                                   | -58.83    |     |                   |                          |  |           |

Weighted mean ..... +47.34  
 $V_a$  ..... 23.65  
 $V_d$  ..... -10  
 Curvature ..... 28  
 Radial velocity ..... +23.5

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1909. Feb. 13.  
G. M. T. 12<sup>h</sup> 27<sup>m</sup> $\beta$  ORIONIS 2278.Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3466           |                          |  |           | 2   | 58.8021           |                          |  |           |
| 2   | 61.3632           |                          |  |           | 2   | 36.1817           |                          |  |           |
| 3   | 61.3156           | 2975                     | 1175                                   | +48.37    | 1   | 36.1930           | 2055                     | 1150                                   | +40.31    |
| 2   | 59.7290           | 7110                     | 1145                                   | 46.84     |     |                   |                          |  |           |

Weighted mean..... +46.52  
 $V_a$ ..... -24.00  
 $V_d$ ..... .00  
 Curvature..... - .28  
 Radial velocity..... +22.2

1909. Feb. 13.  
G. M. T. 12<sup>h</sup> 40<sup>m</sup> $\beta$  ORIONIS 2279.Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3312           |                          |  |           | 2   | 58.7858           |                          |  |           |
| 2   | 61.3531           |                          |  |           | 2   | 36.1657           |                          |  |           |
| 3   | 61.3032           | 2970                     | 1165                                   | +48.16    | 1½  | 36.1698           | 1983                     | 1078                                   | +37.78    |
| 2   | 59.7212           | 7180                     | 1215                                   | 49.71     |     |                   |                          |  |           |

Weighted mean..... +46.24  
 $V_a$ ..... -24.00  
 $V_d$ ..... .00  
 Curvature..... - .28  
 Radial velocity..... +22.0

1909. Feb. 13.  
G. M. T. 12<sup>h</sup> 53<sup>m</sup> $\beta$  ORIONIS 2280.Observed by J. S. PLASKETT.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3520           |                          |  |           | 2   | 58.8035           |                          |  |           |
| 2   | 61.3710           |                          |  |           | 2   | 36.1748           |                          |  |           |
| 3   | 61.3192           | 2940                     | 1135                                   | +46.92    | 1   | 36.1848           | 2042                     | 1137                                   | +39.85    |
| 2   | 59.7314           | 7165                     | 1140                                   | 46.64     |     |                   |                          |  |           |

Weighted mean..... +45.65  
 $V_a$ ..... -24.00  
 $V_d$ ..... .00  
 Curvature..... - .28  
 Radial velocity..... +21.4

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$\beta$  ORIONIS 2284.

1909. Feb. 20.  
G. M. T. 12<sup>h</sup> 29<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3507           |                          |   |           | 2   | 58.8010           |                          |   |           |
| 2   | 61.3686           |                          |   |           | 2   | 36.1520           |                          |   |           |
| 3   | 61.2988           | 3100                     | 0977                                    | +40.27    | 2   | 36.1728           | 1730                     | 1249                                    | +43.78    |
| 1   | 59.7346           | 7440                     | 1202                                    | 49.33     |     |                   |                          |   |           |

Weighted mean ..... +42.95  
 $V_a$  ..... -24.82  
 $V_d$  ..... - .08  
 Curvature ..... - .28  
 Radial velocity ..... +17.7

$\beta$  ORIONIS 2285.

1909. Feb. 20.  
G. M. T. 13<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3177           |                          |   |           | 2   | 58.7696           |                          |   |           |
| 2   | 61.3352           |                          |   |           | 2   | 36.1246           |                          |   |           |
| 2   | 61.2860           | 3278                     | 1155                                    | +47.61    | 1½  | 36.1377           | 1653                     | 1172                                    | +41.08    |
| 1   | 59.7262           | 7665                     | 1427                                    | 58.21     |     |                   |                          |   |           |

Weighted mean ..... +47.79  
 $V_a$  ..... -24.82  
 $V_d$  ..... - .08  
 Curvature ..... - .28  
 Radial velocity ..... +22.6

$\beta$  ORIONIS 2286.

1909. Feb. 20.  
G. M. T. 15<sup>h</sup> 12<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displ <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3440           |                          |   |           | 2   | 58.7989           |                          |   |           |
| 2   | 61.3648           |                          |   |           | 2   | 36.1571           |                          |   |           |
| 2   | 61.3160           | 3320                     | 1197                                    | +49.34    | 1½  | 36.1733           | 1684                     | 1203                                    | +42.16    |
| 1   | 59.7233           | 7245                     | 1007                                    | 41.08     |     |                   |                          |   |           |

Weighted mean ..... +45.14  
 $V_a$  ..... -24.82  
 $V_d$  ..... - .08  
 Curvature ..... - .28  
 Radial velocity ..... +19.8

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$\beta$  ORIONIS 2288.

1909. Feb. 21.  
G. M. T. 12<sup>h</sup> 57<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3644           |                          |  |           | 2   | 58.8118           |                          |  |           |
| 2   | 61.3779           |                          |  |           | 2   | 36.1550           |                          |  |           |
| 2   | 61.3268           | 3250                     | 1127                                   | +46.45    | 1   | 36.1798           | 1770                     | 1770                                   | +45.18    |
| 1   | 59.7422           | 7400                     | 1162                                   | 47.40     |     |                   |                          |  |           |

Weighted mean ..... + 46.45  
 $V_a$  ..... - 25.04  
 $V_d$  ..... .09  
 Curvature ..... .28  
 Radial velocity ..... + 21.0

$\beta$  ORIONIS 2289.

1909. Feb. 21.  
G. M. T. 13<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3543           |                          |  |           | 2   | 58.8071           |                          |  |           |
| 2   | 61.3695           |                          |  |           | 2   | 36.1572           |                          |  |           |
| 2   | 61.3040           | 3165                     | 9982                                   | +40.48    | 2   | 36.1726           | 1676                     | 1195                                   | +41.88    |
| 1   | 59.7518           | 7545                     | 1397                                   | 53.39     |     |                   |                          |  |           |

Weighted mean ..... + 45.62  
 $V_a$  ..... - 25.04  
 $V_d$  ..... .09  
 Curvature ..... .28  
 Radial velocity ..... + 18.2

$\beta$  ORIONIS 2290.

1909. Feb. 21.  
G. M. T. 13<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ms</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3632           |                          |  |           | 2   | 58.8130           |                          |  |           |
| 2   | 61.3830           |                          |  |           | 2   | 36.1631           |                          |  |           |
| 2   | 61.3238           | 3200                     | 1077                                   | +44.39    | 2   | 36.1767           | 1658                     | 1177                                   | +41.25    |
| 1   | 59.7450           | 7415                     | 1177                                   | 48.01     |     |                   |                          |  |           |

Weighted mean ..... + 43.86  
 $V_a$  ..... - 25.04  
 $V_d$  ..... .09  
 Curvature ..... .28  
 Radial velocity ..... + 18.4



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$\beta$  ORIONIS 2291.

1909, Feb. 21.  
G. M. T. 13<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 63.3650           |                          |  |           | 2   | 58.8109           |                          |  |           |
| 2               | 61.3777           |                          |  |           | 2   | 36.1475           |                          |  |           |
| 3               | 61.3190           | 3170                     | 1017                                   | 43.16     | 2   | 36.1659           | 1796                     | 1225                                   | 42.94     |
| 1 $\frac{1}{2}$ | 59.7433           | 7416                     | 1168                                   | 47.64     |     |                   |                          |  |           |

Weighted mean ..... - 44.13  
 $V_a$  ..... 25.04  
 $V_d$  ..... .09  
 Curvature ..... - 28  
 Radial velocity ..... 48.7

$\beta$  ORIONIS 2292.

1909, Feb. 22.  
G. M. T. 12<sup>h</sup> 02<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3642           |                          |  |           | 2   | 58.8102           |                          |  |           |
| 2   | 61.3755           |                          |  |           | 2   | 36.1595           |                          |  |           |
| 2   | 61.3167           | 3157                     | 1034                                   | 42.62     | 1   | 36.1831           | 1758                     | 1277                                   | 44.76     |
| 1   | 59.7493           | 7483                     | 1245                                   | 50.78     |     |                   |                          |  |           |

Weighted mean ..... 45.19  
 $V_a$  ..... 25.14  
 $V_d$  ..... .02  
 Curvature ..... - 28  
 Radial velocity ..... - 19.7

$\beta$  ORIONIS 2293.

1909, Feb. 22.  
G. M. T. 12<sup>h</sup> 15<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3503           |                          |  |           | 2   | 58.8000           |                          |  |           |
| 2   | 61.3637           |                          |  |           | 2   | 36.1558           |                          |  |           |
| 2   | 61.3018           | 3125                     | 1002                                   | 41.30     | 1   | 36.1807           | 1771                     | 1290                                   | 45.21     |
| 1   | 59.7474           | 7570                     | 1332                                   | 54.33     |     |                   |                          |  |           |

Weighted mean ..... + 45.58  
 $V_a$  ..... - 25.11  
 $V_d$  ..... .02  
 Curvature ..... - 28  
 Radial velocity ..... + 25.1

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1909. Feb. 22.  
G. M. T. 12<sup>h</sup> 30<sup>m</sup> $\beta$  ORIONIS 2294.Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3495           |                          |  |           | 2   | 58 8022           |                          |  |           |
| 2   | 63 3678           |                          |  |           | 2   | 36 1610           |                          |  |           |
| 2   | 61 3121           | 3210                     | 1087                                   | -44 81    | 2   | 36 1809           | 1720                     | 1239                                   | +43 43    |
| 1½  | 59 7381           | 7458                     | 1220                                   | 49 76     |     |                   |                          |  |           |

Weighted mean ..... -45 66

 $V_a$  ..... -25 14 $V_d$  ..... - 02

Curvature ..... - 28

Radial velocity ..... +20 2

 $\beta$  ORIONIS 2295.1909. Feb. 22.  
G. M. T. 12<sup>h</sup> 42<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3622           |                          |  |           | 2   | 58 8095           |                          |  |           |
| 2   | 61 3780           |                          |  |           | 2   | 36 1677           |                          |  |           |
| 2   | 61 3248           | 3280                     | 1157                                   | -47 69    | 1½  | 36 1881           | 1726                     | 1245                                   | +43 64    |
| 2   | 59 7345           | 7344                     | 1106                                   | 45 11     |     |                   |                          |  |           |

Weighted mean ..... +45 65

 $V_a$  ..... -25 14 $V_d$  ..... - 02

Curvature ..... - 28

Radial velocity ..... +20 2

 $\beta$  ORIONIS 2309.1909. Feb. 27.  
G. M. T. 11<sup>h</sup> 35<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3682           |                          |  |           | 2   | 58 8129           |                          |  |           |
| 2   | 61 3790           |                          |  |           | 2   | 36 1491           |                          |  |           |
| 2   | 61 3288           | 3240                     | 1117                                   | +46 04    | 2   | 36 1814           | 1845                     | 1364                                   | +47 81    |
| 1½  | 59 7498           | 7460                     | 1222                                   | 49 85     |     |                   |                          |  |           |

Weighted mean ..... +47 71

 $V_a$  ..... -25 48 $V_d$  ..... 00

Curvature ..... - 28

Radial velocity ..... +22 0

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$\beta$  ORIONIS 2311.

1909, Feb. 28,  
G. M. T. 11<sup>h</sup> 56<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3272           |                          |  |           | 2   | 58 7792           |                          |  |           |
| 2   | 63 3402           |                          |  |           | 2   | 36 1567           |                          |  |           |
| 2   | 61 2899           | 2940                     | 1135                                   | +46 92    | 13  | 36 1805           | 2180                     | 1275                                   | +44 83    |
| 1½  | 59 7215           | 7250                     | 1285                                   | 52 63     |     |                   |                          |  |           |

Weighted mean..... +48 01  
 $V_a$ ..... -25 53  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +22 2

$\beta$  ORIONIS 2312.

1909, Feb. 28,  
G. M. T. 12<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3345           |                          |  |           | 2   | 58 7913           |                          |  |           |
| 2   | 61 3567           |                          |  |           | 2   | 36 1739           |                          |  |           |
| 3   | 61 2980           | 2900                     | 1085                                   | +44 85    | 2   | 36 2948           | 2251                     | 1346                                   | +47 33    |
| 2   | 59 7342           | 7260                     | 1295                                   | 53 04     |     |                   |                          |  |           |

Weighted mean..... +47 90  
 $V_a$ ..... -25 53  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +22 0

$\beta$  ORIONIS 2313.

1909, Feb. 28,  
G. M. T. 12<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3394           |                          |  |           | 2   | 58 7911           |                          |  |           |
| 2   | 61 3602           |                          |  |           | 2   | 36 1740           |                          |  |           |
| 2   | 61 3112           | 3000                     | 1195                                   | +49 40    | 1   | 36 1806           | 2026                     | 1121                                   | +39 41    |
| 1   | 59 7515           | 7435                     | 1470                                   | 60 21     |     |                   |                          |  |           |

Weighted mean..... +49 61  
 $V_a$ ..... -25 53  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +23 7

$\beta$  ORIONIS 2314.

1909. Feb. 28.  
G. M. T. 12<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3298           |                          |  |           | 2   | 58 7866           |                          |  |           |
| 2   | 61 3467           |                          |  |           | 2   | 36 1742           |                          |  |           |
| 2   | 61 3037           | 3005                     | 1200                                   | -49 61    | 1½  | 36 1998           | 2198                     | 1293                                   | -45 46    |
| 1½  | 59 7434           | 7498                     | 1443                                   | 59 11     |     |                   |                          |  |           |

Weighted mean..... +51 22  
 $V_a$ ..... -25 53  
 $V_d$ ..... .02  
 Curvature..... .28

Radial velocity..... +25 3

$\beta$  ORIONIS 2315.

1909. Feb. 28.  
G. M. T. 12<sup>h</sup> 39<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3247           |                          |  |           | 2   | 58 7759           |                          |  |           |
| 2   | 61 3422           |                          |  |           | 2   | 36 1541           |                          |  |           |
| 3   | 61 2979           | 3005                     | 1200                                   | -49 61    | 2   | 36 1757           | 2158                     | 1253                                   | +44 06    |
| 1½  | 59 7148           | 7215                     | 1250                                   | 51 14     |     |                   |                          |  |           |

Weighted mean..... +48 26  
 $V_a$ ..... -25 53  
 $V_d$ ..... .02  
 Curvature..... .28

Radial velocity..... -22 4

$\beta$  ORIONIS 2316.

1909. Feb. 28.  
G. M. T. 12<sup>h</sup> 50<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3355           |                          |  |           | 2   | 58 7887           |                          |  |           |
| 2   | 61 3528           |                          |  |           | 2   | 36 1782           |                          |  |           |
| 2   | 61 2998           | 2920                     | 1115                                   | -46 09    | 1½  | 36 1944           | 2105                     | 1200                                   | +42 19    |
| 1½  | 59 7455           | 7400                     | 1435                                   | 58 71     |     |                   |                          |  |           |

Weighted mean..... +48 71  
 $V_a$ ..... -25 53  
 $V_d$ ..... .02  
 Curvature..... .28

Radial velocity..... -22 8

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$\beta$  ORIONIS 2317.

1909, Mar. 2,  
G. M. T. 11<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3647           |                          |  |           | 2   | 58 8147           |                          |  |           |
| 2   | 61 3807           |                          |  |           | 2   | 36 1744           |                          |  |           |
| 2   | 61 3360           | 3320                     | 1197                                   | +49 34    | 1½  | 36 1960           | 1738                     | 1257                                   | +44 06    |
| 2   | 59 7707           | 7655                     | 1417                                   | 57 80     |     |                   |                          |  |           |

Weighted mean..... +50 97  
 $V_a$ ..... -25 61  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +25 9

$\beta$  ORIONIS 2318.

1909, Mar. 2,  
G. M. T. 11<sup>h</sup> 19<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3626           |                          |  |           | 2   | 59 8975           |                          |  |           |
| 2   | 61 3804           |                          |  |           | 2   | 36 1516           |                          |  |           |
| 2   | 61 3217           | 3210                     | 1087                                   | +44 81    | 1½  | 36 1860           | 1866                     | 1385                                   | +48 54    |
| 2   | 59 7622           | 7640                     | 1402                                   | 57 19     |     |                   |                          |  |           |

Weighted mean..... +50 33  
 $V_a$ ..... -25 61  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +24 4

$\beta$  ORIONIS 2319.

1909, Mar. 2,  
G. M. T. 11<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3438           |                          |  |           | 2   | 58 7920           |                          |  |           |
| 2   | 61 3600           |                          |  |           | 2   | 36 1442           |                          |  |           |
| 2   | 61 3090           | 3200                     | 1137                                   | +46 87    | 2   | 36 1763           | 1843                     | 1363                                   | +47 77    |
| 1½  | 59 7476           | 7650                     | 1412                                   | 57 59     |     |                   |                          |  |           |

Weighted mean..... +50 12  
 $V_a$ ..... -25 61  
 $V_d$ ..... - 02  
 Curvature..... - 28

Radial velocity..... +24 2

$\beta$  ORIONIS 2320.

1909, Mar. 2.  
G. M. T. 11<sup>h</sup> 36<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3522           |                          |   |           | 2   | 58 7996           |                          |   |           |
| 2   | 61 3707           |                          |   |           | 2   | 36 1541           |                          |   |           |
| 2   | 61 3197           | 3290                     | 1167                                    | +48.10    | 2   | 36 1921           | 1902                     | 1421                                    | +49.81    |
| 1½  | 59 7315           | 7312                     | 1074                                    | 43.81     |     |                   |                          |   |           |

Weighted mean ..... +47.55  
 $V_a$  ..... -25.61  
 $V_d$  ..... - .02  
 Curvature..... - .28  
 Radial velocity ..... +21.6

$\beta$  ORIONIS 2364.

1909, Mar. 13  
G. M. T. 12<sup>h</sup> 12<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3696           |                          |   |           | 2   | 58 8145           |                          |   |           |
| 2   | 61 3870           |                          |   |           | 2   | 36 1448           |                          |   |           |
| 2   | 61 3327           | 3250                     | 1127                                    | +46.5     | 1½  | 36 1611           | 1685                     | 1204                                    | +42.2     |
| 1½  | 59 7380           | 7320                     | 1082                                    | 44.1      |     |                   |                          |   |           |

Weighted mean ..... +44.50  
 $V_a$  ..... -25.45  
 $V_d$  ..... - .16  
 Curvature..... - .28  
 Radial velocity ..... +18.6

$\beta$  ORIONIS 2365.

1909, Mar. 13  
G. M. T. 12<sup>h</sup> 24<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63 3760           |                          |   |           | 2   | 58 8161           |                          |   |           |
| 2   | 61 3876           |                          |   |           | 2   | 36 1348           |                          |   |           |
| 3   | 61 3228           | 3120                     | 0997                                    | +41.1     | 1½  | 36 1591           | 1765                     | 1284                                    | +45.0     |
| 2   | 59 7507           | 7425                     | 1187                                    | 48.4      |     |                   |                          |   |           |

Weighted mean ..... +44.25  
 $V_a$  ..... -25.45  
 $V_d$  ..... - .16  
 Curvature..... - .28  
 Radial velocity ..... +18.4

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$\beta$  ORIONIS 2366.

1909. Mar. 13.  
G. M. T. 12<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63 3662           | .....                    | .....                      | .....     | 2   | 58 8142           | .....                    | .....                      | .....     |
| 2   | 61 3821           | .....                    | .....                      | .....     | 2   | 36 1400           | .....                    | .....                      | .....     |
| 2   | 61 3198           | 3160                     | 1037                       | +42.7     | 1½  | 36 1692           | 1814                     | 1333                       | +46.7     |
| 1½  | 59 7506           | 7475                     | 1237                       | 50.4      |     |                   |                          |                            |           |

Weighted mean ..... +46.21  
 $V_a$  ..... -25.45  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +20.3

$\beta$  ORIONIS 2367.

1909. Mar. 13.  
G. M. T. 12<sup>h</sup> 46<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63 3600           | .....                    | .....                      | .....     | 2   | 58 7981           | .....                    | .....                      | .....     |
| 2   | 61 3738           | .....                    | .....                      | .....     | 2   | 36 1272           | .....                    | .....                      | .....     |
| 2½  | 61 3086           | 3125                     | 1002                       | +41.30    | 1½  | 36 1460           | 1710                     | 1229                       | +43.10    |
| 1½  | 59 7297           | 7400                     | 1162                       | 47.40     |     |                   |                          |                            |           |

Weighted mean ..... +43.45  
 $V_a$  ..... -25.45  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +17.6

$\beta$  ORIONIS 2368.

1909. Mar. 13.  
G. M. T. 12<sup>h</sup> 57<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|----------------------------|-----------|-----|-------------------|--------------------------|----------------------------|-----------|
| 2   | 63 3640           | .....                    | .....                      | .....     | 2   | 58 8093           | .....                    | .....                      | .....     |
| 2   | 61 3800           | .....                    | .....                      | .....     | 2   | 36 1354           | .....                    | .....                      | .....     |
| 2   | 61 3300           | 3280                     | 1157                       | +47.7     | 1½  | 36 1578           | 1746                     | 1265                       | +44.3     |
| 2   | 59 7306           | 7300                     | 1062                       | 43.3      |     |                   |                          |                            |           |

Weighted mean ..... +45.17  
 $V_a$  ..... -25.45  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... +19.3

1909, Mar. 15,  
G. M. T. 11<sup>h</sup> 45<sup>m</sup>

3 ORIONIS 2372.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|------------------|-------------------------|--|-----------|-----|------------------|-------------------------|--|-----------|
| 2   | 63 3472          |                         |  |           | 2   | 58 8015          |                         |  |           |
| 2   | 61 3664          |                         |  |           | 2   | 36 1624          |                         |  |           |
| 2   | 61 3098          | 2890                    | 1085                                   | -44 85    | 1½  | 36 1712          | 2030                    | 1125                                   | +39 55    |
| 1   | 59 7205          | 7075                    | 1050                                   | 42 96     |     |                  |                         |  |           |

Weighted mean ..... +42 66  
*V<sub>a</sub>* ..... -25 34  
*V<sub>d</sub>* ..... - 14  
 Curvature..... - 28

Radial velocity..... +16 9

3 ORIONIS 2373.

1909, Mar. 15,  
G. M. T. 11<sup>h</sup> 56<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|------------------|-------------------------|--|-----------|-----|------------------|-------------------------|--|-----------|
| 2   | 63 3475          |                         |  |           | 2   | 58 7985          |                         |  |           |
| 2   | 61 3660          |                         |  |           | 2   | 36 1478          |                         |  |           |
| 2½  | 61 3094          | 2890                    | 1085                                   | -44 85    | 1½  | 36 1697          | 2161                    | 1256                                   | +44 16    |
| 1   | 59 7421          | 7260                    | 1255                                   | 52 98     |     |                  |                         |  |           |

Weighted mean ..... +46 27  
*V<sub>a</sub>* ..... -25 34  
*V<sub>d</sub>* ..... - 14  
 Curvature..... - 28

Radial velocity..... +20 5

3 ORIONIS 2374.

1909, Mar. 15,  
G. M. T. 12<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings | Corrected Star Settings | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|------------------|-------------------------|--|-----------|-----|------------------|-------------------------|--|-----------|
| 2   | 63 3415          |                         |  |           | 2   | 58 7942          |                         |  |           |
| 2   | 61 3612          |                         |  |           | 2   | 36 1598          |                         |  |           |
| 2   | 61 2924          | 2764                    | 9959                                   | +39 65    | 1½  | 36 1784          | 2128                    | 1223                                   | +43 00    |
| 1   | 59 7336          | 7220                    | 1255                                   | 51 34     |     |                  |                         |  |           |

Weighted mean ..... +43 36  
*V<sub>a</sub>* ..... -25 34  
*V<sub>d</sub>* ..... - 14  
 Curvature..... - 28

Radial velocity..... +17 6



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$\beta$  ORIONIS 2375.

1909. Mar. 15.  
G. M. T. 12<sup>h</sup> 13<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3430           |                          |  |           | 2   | 58.7960           |                          |  |           |
| 2   | 61.3618           |                          |  |           | 2   | 36.1654           |                          |  |           |
| 2   | 61.3146           | .2976                    | .1171                                  | +48.41    | 1½  | 36.1837           | .2125                    | .1223                                  | +43.00    |
| 1½  | 59.7102           | .6972                    | .1007                                  | 41.20     |     |                   |                          |  |           |

Weighted mean ..... +44.62  
*V<sub>a</sub>* ..... -25.34  
*V<sub>d</sub>* ..... 14  
 Curvature ..... 28

Radial velocity..... +18.9

$\beta$  ORIONIS 2376.

1909. Mar. 15.  
G. M. T. 12<sup>h</sup> 21<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3492           |                          |  |           | 2   | 58.8022           |                          |  |           |
| 2   | 61.3678           |                          |  |           | 2   | 36.1743           |                          |  |           |
| 2   | 61.3032           | .2800                    | .0935                                  | +41.13    | 1   | 36.1771           | .1970                    | .1065                                  | +37.45    |
| 1½  | 59.7281           | .7088                    | .1123                                  | 45.94     |     |                   |                          |  |           |

Weighted mean ..... +41.92  
*V<sub>a</sub>* ..... -25.34  
*V<sub>d</sub>* ..... 14  
 Curvature ..... 28

Radial velocity..... -16.2

$\beta$  ORIONIS 2386.

1909. Mar. 18.  
G. M. T. 11<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3427           |                          |  |           | 2   | 58.7936           |                          |  |           |
| 2   | 61.3610           |                          |  |           | 2   | 36.1518           |                          |  |           |
| 3   | 61.3020           | .3185                    | .1062                                  | -43.78    | 1   | 36.1820           | .1824                    | .1343                                  | +47.97    |
| 2   | 59.7188           | .7346                    | .1108                                  | 45.20     |     |                   |                          |  |           |

Weighted mean ..... +44.98  
*V<sub>a</sub>* ..... -25.09  
*V<sub>d</sub>* ..... 15  
 Curvature ..... 28

Radial velocity..... +19.5

1909, Mar. 18.  
G. M. T. 11<sup>h</sup> 52<sup>m</sup>

$\beta$  ORIONIS 2387.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3645           | .....                    | .....                                  | .....     | 2   | 58 8071           | .....                    | .....                                  | .....     |
| 2   | 61 3782           | .....                    | .....                                  | .....     | 2   | 36 1581           | .....                    | .....                                  | .....     |
| 2   | 61 3205           | 3200                     | 1077                                   | +44 39    | 1   | 36 1684           | 1625                     | 1144                                   | +40 10    |
| 1½  | 59 7465           | 7480                     | 1242                                   | 50 66     |     |                   |                          |  |           |

Weighted mean..... +45 53  
 $V_a$ ..... -25 09  
 $V_d$ ..... - 15  
 Curvature..... - 28

Radial velocity..... +20 0

1909, Mar. 18.  
G. M. T. 12<sup>h</sup> 02<sup>m</sup>

$\beta$  ORIONIS 2388.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3541           | .....                    | .....                                  | .....     | 2   | 58 8001           | .....                    | .....                                  | .....     |
| 2   | 61 3718           | .....                    | .....                                  | .....     | 2   | 36 1635           | .....                    | .....                                  | .....     |
| 2   | 61 3210           | 3280                     | 1157                                   | +47 69    | 1½  | 36 1828           | 1715                     | 1235                                   | +43 29    |
| 1½  | 59 7396           | 7480                     | 1242                                   | 50 66     |     |                   |                          |  |           |

Weighted mean..... +47 26  
 $V_a$ ..... -25 09  
 $V_d$ ..... - 15  
 Curvature..... - 28

Radial velocity..... +21 7

1909, Mar. 18.  
G. M. T. 12<sup>h</sup> 12<sup>m</sup>

$\beta$  ORIONIS 2389.

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3192           | .....                    | .....                                  | .....     | 2   | 58 7998           | .....                    | .....                                  | .....     |
| 2   | 61 3646           | .....                    | .....                                  | .....     | 2   | 36 1597           | .....                    | .....                                  | .....     |
| 1½  | 61 2927           | 3050                     | 0927                                   | -38 21    | 1½  | 36 1954           | 1879                     | 1398                                   | +49 00    |
| 2   | 59 7380           | 7485                     | 1247                                   | 50 86     |     |                   |                          |  |           |

Weighted mean..... +46 51  
 $V_a$ ..... -25 09  
 $V_d$ ..... - 15  
 Curvature..... - 28

Radial velocity..... +21 0

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$\beta$  ORIONIS 2390.

1909, Mar. 20,  
G. M. T. 12<sup>h</sup> 16<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| 2               | 63 3657           |                          |  |           | 2               | 58 8128           |                          |  |           |
| 2               | 61 3836           |                          |  |           | 2               | 36 1496           |                          |  |           |
| 2 $\frac{1}{2}$ | 61 3307           | 3360                     | 1137                                   | +46 86    | 1 $\frac{1}{2}$ | 36 1655           | 1681                     | 1200                                   | +42 06    |
| 1 $\frac{1}{2}$ | 59 7601           | 7561                     | 1323                                   | 53 96     |                 |                   |                          |  |           |

Weighted mean ..... +47 49  
 $V_a$  ..... -24 88  
 $V_d$  ..... - 12  
 Curvature ..... - 28

Radial velocity ..... +22 2

$\beta$  ORIONIS 2391.

1909, Mar. 20,  
G. M. T. 12<sup>h</sup> 26<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----------------|-------------------|--------------------------|--|-----------|
| 2               | 63 3724           |                          |  |           | 2               | 58 8192           |                          |  |           |
| 2               | 61 3859           |                          |  |           | 2               | 36 1414           |                          |  |           |
| 2               | 61 3292           | 3192                     | 1069                                   | +44 06    | 1 $\frac{1}{2}$ | 36 1637           | 1745                     | 1264                                   | +44 30    |
| 1 $\frac{1}{2}$ | 59 7592           | 7292                     | 1054                                   | 42 99     |                 |                   |                          |  |           |

Weighted mean ..... +43 81  
 $V_a$  ..... -24 88  
 $V_d$  ..... - 12  
 Curvature ..... - 28

Radial velocity ..... +18 3

$\beta$  ORIONIS 2392.

1909, Mar. 20,  
G. M. T. 12<sup>h</sup> 38<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2               | 63 3775           |                          |  |           | 2   | 58 8197           |                          |  |           |
| 2               | 61 3892           |                          |  |           | 2   | 36 1569           |                          |  |           |
| 3               | 61 3352           | 3320                     | 1197                                   | +49 34    | 2   | 36 1862           | 1825                     | 1334                                   | +46 76    |
| 1 $\frac{1}{2}$ | 59 7575           | 7460                     | 1222                                   | 49 85     |     |                   |                          |  |           |

Weighted mean ..... +48 66  
 $V_a$  ..... -24 88  
 $V_d$  ..... - 12  
 Curvature ..... - 28

Radial velocity ..... +25 4

1909. Mar. 20.  
G. M. T. 12<sup>h</sup> 48<sup>m</sup>

3 ORIONIS 2393.

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3659           |                          |  |           | 2   | 58 8108           |                          |  |           |
| 2   | 61 3800           |                          |  |           | 2   | 36 1480           |                          |  |           |
| 2   | 61 3215           | 3184                     | 1061                                     | -43.73    | 1½  | 36 1857           | 1900                     | 1419                                     | +49.74    |
| 1½  | 59 7468           | 7448                     | 1210                                     | 49.36     |     |                   |                          |  |           |

Weighted mean..... +47.22  
 $V_a$ ..... -24.88  
 $V_d$ ..... .12  
 Curvature..... - .28

Radial velocity..... +21.9

3 ORIONIS 2394.

1909. Mar. 20.  
G. M. T. 12<sup>h</sup> 58<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3661           |                          |  |           | 2   | 58 8130           |                          |  |           |
| 2   | 61 3815           |                          |  |           | 2   | 36 1565           |                          |  |           |
| 2   | 61 3319           | 3275                     | 1152                                     | +47.49    | 1½  | 36 1806           | 1763                     | 1282                                     | +44.93    |
| 1½  | 59 7587           | 7547                     | 1309                                     | 53.39     |     |                   |                          |  |           |

Weighted mean..... +48.40  
 $V_a$ ..... -24.88  
 $V_d$ ..... .12  
 Curvature..... - .28

Radial velocity..... +23.1

3 ORIONIS 2397.

1909. Mar. 21.  
G. M. T. 13<sup>h</sup> 38<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> . | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3695           |                          |  |           | 2   | 58 8189           |                          |  |           |
| 2   | 61 3856           |                          |  |           | 2   | 36 1752           |                          |  |           |
| 2   | 61 3328           | 3240                     | 1117                                     | +46.07    | 1½  | 36 2220           | 1999                     | 1509                                     | +52.89    |
| 2   | 59 7550           | 7460                     | 1222                                     | 49.85     |     |                   |                          |  |           |

Weighted mean..... +49.30  
 $V_a$ ..... -24.76  
 $V_d$ ..... .32  
 Curvature..... - .28

Radial velocity..... +23.9

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$\beta$  ORIONIS 2398.

1909, Mar. 21,  
G. M. T. 13<sup>h</sup> 48<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3667           |                          |  |           | 2   | 58.8120           |                          |  |           |
| 2   | 61.3818           |                          |  |           | 2   | 36.1571           |                          |  |           |
| 2   | 61.3396           | 3250                     | 1227                                   | +50.60    | 2   | 36.2053           | 2004                     | 1523                                   | +53.38    |
| 2   | 59.7441           | 7410                     | 1172                                   | 47.81     |     |                   |                          |  |           |

Weighted mean ..... +50.60  
 $V_a$  ..... -24.76  
 $V_d$  ..... -32  
 Curvature ..... 28  
 Radial velocity ..... -25.2

$\beta$  ORIONIS 2399.

1909, Mar. 21,  
G. M. T. 14<sup>h</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3483           |                          |  |           | 2   | 58.7972           |                          |  |           |
| 2   | 61.3664           |                          |  |           | 2   | 36.1511           |                          |  |           |
| 2   | 61.3124           | 3245                     | 1122                                   | +46.27    | 1   | 36.1884           | 1894                     | 1414                                   | +49.56    |
| 2   | 59.7452           | 7572                     | 1334                                   | 54.41     |     |                   |                          |  |           |

Weighted mean ..... -50.18  
 $V_a$  ..... -24.76  
 $V_d$  ..... -32  
 Curvature ..... 28  
 Radial velocity ..... -24.8

$\beta$  ORIONIS 2400.

1909, Mar. 21,  
G. M. T. 14<sup>h</sup> 14<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----------------|-------------------|--------------------------|--|-----------|---------------|-------------------|--------------------------|--|-----------|
| 2               | 63.3505           |                          |  |           | 2             | 58.8071           |                          |  |           |
| 2               | 61.3712           |                          |  |           | 2             | 36.1516           |                          |  |           |
| 2               | 61.3198           | 3300                     | 1177                                   | +48.54    | $\frac{1}{2}$ | 36.1855           | 1861                     | 1380                                   | +48.37    |
| 1 $\frac{1}{2}$ | 59.7490           | 7580                     | 1342                                   | 54.74     |               |                   |                          |  |           |

Weighted mean ..... -50.84  
 $V_a$  ..... -24.76  
 $V_d$  ..... -32  
 Curvature ..... 28  
 Radial velocity ..... +25.5

$\beta$  ORIONIS 2402.

1909. Mar. 22.  
G. M. T. 11<sup>h</sup> 51<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3584           |                          |   |           | 2   | 58.8043           |                          |   |           |
| 2   | 61.3737           |                          |   |           | 2   | 36.1447           |                          |   |           |
| 2   | 61.3370           | 3410                     | 1287                                    | -53.05    | 1½  | 36.1712           | 1787                     | 1307                                    | +45.81    |
| 1½  | 59.7510           | 7560                     | 1322                                    | 53.92     |     |                   |                          |   |           |

Weighted mean..... +51.14  
 $V_a$ ..... -24.66  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... -26.0

$\beta$  ORIONIS 2403.

1909. Mar. 22.  
G. M. T. 12<sup>h</sup> 02<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3517           |                          |   |           | 2   | 58.8009           |                          |   |           |
| 2   | 61.3688           |                          |   |           | 2   | 36.1536           |                          |   |           |
| 2   | 61.3260           | 3355                     | 1232                                    | +50.78    | 1½  | 36.1846           | 1832                     | 1832                                    | +47.35    |
| 1½  | 59.7423           | 7373                     | 1275                                    | 52.01     |     |                   |                          |   |           |

Weighted mean..... +50.12  
 $V_a$ ..... -24.66  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... +25.0

$\beta$  ORIONIS 2404.

1909. Mar. 22.  
G. M. T. 12<sup>h</sup> 13<sup>m</sup>

Observed by } J. S. PLASKETT.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Dispt <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|---|-----------|-----|-------------------|--------------------------|---|-----------|
| 2   | 63.3608           |                          |   |           | 2   | 58.8094           |                          |   |           |
| 2   | 61.3126           |                          |   |           | 2   | 36.1640           |                          |   |           |
| 2   | 61.3242           | 3260                     | 1137                                    | +46.87    | 1½  | 36.1917           | 1800                     | 1319                                    | +46.23    |
| 1½  | 59.7329           | 7335                     | 1107                                    | 45.15     |     |                   |                          |   |           |

Weighted mean..... +46.16  
 $V_a$ ..... -24.66  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... +21.1

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$\beta$  ORIONIS 2405.

1909, Mar. 22.  
G. M. T. 12<sup>h</sup> 35<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3570           | .....                    | .....                                  | .....     | 2   | 58 8019           | .....                    | .....                                  | .....     |
| 2   | 61 3743           | .....                    | .....                                  | .....     | 2   | 36 1180           | .....                    | .....                                  | .....     |
| 2   | 61 3138           | 3228                     | 1105                                   | +45 55    | 1½  | 36 1698           | 1740                     | 1259                                   | +44 13    |
| 1½  | 59 7375           | 7450                     | 1212                                   | 49 44     |     |                   |                          |  |           |

Weighted mean ..... +46.29  
 $V_a$  ..... -24.66  
 $V_d$  ..... -16  
 Curvature ..... -28

Radial velocity ..... +21.2

$\beta$  ORIONIS 2420.

1909, Mar. 23.  
G. M. T. 11<sup>h</sup> 46<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3586           | .....                    | .....                                  | .....     | 2   | 58 8059           | .....                    | .....                                  | .....     |
| 2   | 61 3757           | .....                    | .....                                  | .....     | 2   | 36 1332           | .....                    | .....                                  | .....     |
| 1½  | 61 3160           | 3190                     | 1067                                   | +43 99    | 2   | 36 1699           | 1889                     | 1408                                   | +49 35    |
| 1½  | 59 7445           | 7480                     | 1242                                   | 50 66     |     |                   |                          |  |           |

Weighted mean ..... +48.14  
 $V_a$  ..... -24.54  
 $V_d$  ..... -19  
 Curvature ..... -28

Radial velocity ..... +23.1

$\beta$  ORIONIS 2421.

1909, Mar. 23.  
G. M. T. 11<sup>h</sup> 57<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63 3700           | .....                    | .....                                  | .....     | 2   | 58 8151           | .....                    | .....                                  | .....     |
| 2   | 61 3809           | .....                    | .....                                  | .....     | 2   | 36 1310           | .....                    | .....                                  | .....     |
| 2½  | 61 3418           | 3358                     | 1235                                   | +50 92    | 2   | 36 1608           | 1820                     | 1339                                   | +46 93    |
| 1½  | 59 7447           | 7390                     | 1152                                   | 49 99     |     |                   |                          |  |           |

Weighted mean ..... +49.36  
 $V_a$  ..... -24.54  
 $V_d$  ..... -19  
 Curvature ..... -28

Radial velocity ..... +24.4

1909, Mar. 23.  
G. M. T. 12<sup>h</sup> 05<sup>m</sup>

$\beta$  ORIONIS 2422.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 63 3572           |                          |                                       |           | 2   | 58 8081           |                          |                                       |           |
| 2   | 61 3728           |                          |                                       |           | 2   | 36 1372           |                          |                                       |           |
| 2   | 61 3253           | 3290                     | 1177                                  | -48 53    | 2   | 36 1920           | 2070                     | 1589                                  | +55 69    |
| 1   | 59 7348           | 7370                     | 1132                                  | 46 17     |     |                   |                          |                                       |           |

Weighted mean..... +50 92  
 $V_a$ ..... -24 54  
 $V_d$ ..... - 19  
 Curvature..... - 28

Radial velocity..... +25 9

1909, Mar. 23.  
G. M. T. 12<sup>h</sup> 13<sup>m</sup>

$\beta$  ORIONIS 2423.

Observed by J. S. PLASKETT.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 63 3787           |                          |                                       |           | 2   | 58 8225           |                          |                                       |           |
| 2   | 61 3936           |                          |                                       |           | 2   | 36 1500           |                          |                                       |           |
| 2   | 61 3330           | 3170                     | 1047                                  | +43 17    | 2   | 36 2082           | 2104                     | 1623                                  | +56 89    |
| 2   | 59 7696           | 7551                     | 1313                                  | 53 56     |     |                   |                          |                                       |           |

Weighted mean..... +51 21  
 $V_a$ ..... -24 54  
 $V_d$ ..... - 19  
 Curvature..... - 28

Radial velocity..... +26 2

1909, Mar. 23.  
G. M. T. 12<sup>h</sup> 27<sup>m</sup>

$\beta$  ORIONIS 2424.

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>m</sup> | Velocity. |
|-----|-------------------|--------------------------|---------------------------------------|-----------|-----|-------------------|--------------------------|---------------------------------------|-----------|
| 2   | 63 3774           |                          |                                       |           | 2   | 58 8212           |                          |                                       |           |
| 2   | 61 3930           |                          |                                       |           | 2   | 36 1341           |                          |                                       |           |
| 1½  | 61 3425           | 3275                     | 1152                                  | -47 51    | 2   | 36 1822           | 1997                     | 1516                                  | +53 14    |
| 1½  | 59 7590           | 7465                     | 1227                                  | 50 35     |     |                   |                          |                                       |           |

Weighted mean..... +50 52  
 $V_a$ ..... -24 54  
 $V_d$ ..... - 19  
 Curvature..... - 28

Radial velocity..... +25 5



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$\beta$  ORIONIS 2425.

1909. Mar. 23.  
G. M. T. 12<sup>h</sup> 38<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. S. PLASKETT.

| Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Disp <sup>t</sup> in rev <sup>ns</sup> | Velocity. |
|-----|-------------------|--------------------------|--|-----------|-----|-------------------|--------------------------|--|-----------|
| 2   | 63.3650           | .....                    | .....                                  | .....     | 2   | 58.8098           | .....                    | .....                                  | .....     |
| 2   | 61.3793           | .....                    | .....                                  | .....     | 2   | 36.1269           | .....                    | .....                                  | .....     |
| 2   | 61.3350           | 3327                     | 1204                                   | +19.65    | 1½  | 36.1707           | 1960                     | 1479                                   | -51.84    |
| 1½  | 59.7498           | 7490                     | 1252                                   | 51.07     |     |                   |                          |  |           |

Weighted mean ..... -50.72  
 $V_a$ ..... -25.54  
 $V_d$ ..... -19  
 Curvature..... -28

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Radial velocity..... -25.7

OBSERVING RECORD AND DETAILED MEASURES OF  $\theta$  AQUILÆ.

RECORD OF SPECTROGRAMS.

P.—Plaskett.  
Pl.—Parker.  
H.—Harper.  
C.—Cannon.  
T.—Tribble.

| Star.           | No. of Negative. | Camera. | Plate. | Date.         | Middle of Exposure, G.M.T. | Duration. | Hour Angle at end. | TEMPERATURE CENTIGRADE. |      |            |      | Slit Width. | Seeing.   | Observer. | Remarks.    |
|-----------------|------------------|---------|--------|---------------|----------------------------|-----------|--------------------|-------------------------|------|------------|------|-------------|-----------|-----------|-------------|
|                 |                  |         |        |               |                            |           |                    | Room.                   |      | Prism Box. |      |             |           |           |             |
|                 |                  |         |        |               | h. m.                      | m.        | h. m.              | Begin.                  | End. | Begin.     | End. |             |           |           |             |
| $\theta$ Aquilæ | 1638             | 1L      | Secd   | 1907.         | 15 15                      | 41        | 1 55 W.            | 16.8                    | 15.7 | 29.9       | 29.9 | .0012       | Good      | T         |             |
| "               | 1630             | "       | "      | Sept. 12, 18. | 14 45                      | 37        | 1 40 "             | 12.5                    | 11.7 | 17.0       | 17.0 | .0014       | Unsteady. | T         |             |
| "               | 1533             | "       | "      | 1908          | 29 54                      | 25        | 28 E.              | 11.0                    | 10.5 | 18.0       | 17.9 | .0017       | Good.     | H         |             |
| "               | 1544             | "       | "      | May 15        | 29 19                      | 22        | 25 "               | 15.0                    | 15.0 | 23.4       | 23.4 | .0016       | Hazy.     | H         |             |
| "               | 1576             | "       | "      | " 18          | 30 35                      | 25        | 30 W.              | 12.5                    | 13.0 | 18.3       | 18.3 | .0015       | Fair.     | H         |             |
| "               | 1583             | "       | "      | June 3        | 19 42                      | 45        | 19 E.              | 14.5                    | 14.1 | 24.5       | 24.4 | .0016       | "         | Pl        |             |
| "               | 1604             | "       | "      | " 5           | 19 32                      | 35        | 10 W.              | 15.5                    | 14.7 | 24.8       | 24.6 | .0017       | "         | Pl        |             |
| "               | 1605             | "       | "      | " 12          | 20 15                      | 40        | 45 "               | 14.7                    | 14.4 | 24.6       | 24.5 | "           | Good.     | Pl        |             |
| "               | 1626             | "       | "      | " 22          | 18 35                      | 40        | 10 E.              | 17.5                    | 17.5 | 23.8       | 23.8 | .0015       | Hazy.     | Pl        |             |
| "               | 1634             | "       | "      | " 24          | 19 46                      | 39        | 18.5 W.            | 18.0                    | 18.0 | 27.5       | 27.5 | "           | Good.     | H         |             |
| "               | 1643             | "       | "      | " 26          | 19 42                      | 35        | 15 "               | 17.5                    | 17.3 | 30.0       | 30.0 | .0016       | "         | Pl        |             |
| "               | 1651             | "       | "      | " 27          | 18 45                      | 30        | 20 "               | 19.1                    | 18.7 | 23.4       | 23.3 | .0014       | "         | Pl        |             |
| "               | 1635             | "       | "      | July 7        | 17 30                      | 60        | 25 "               | 21.5                    | 20.5 | 25.4       | 25.4 | .0016       | Hazy.     | H, Pl     |             |
| "               | 1679             | "       | "      | " 8           | 18 49                      | 30        | 1 02 "             | 17.5                    | 17.0 | 21.6       | 21.6 | .0015       | Good.     | H         |             |
| "               | 1691             | "       | "      | " 10          | 19 30                      | 40        | 2 "                | 20.4                    | 19.3 | 28.0       | 26.6 | .0016       | "         | Pl        |             |
| "               | 1696             | "       | "      | " 11          | 19 10                      | 40        | 1 40 "             | 25.4                    | 24.4 | 29.7       | 29.7 | .0015       | "         | Pl        |             |
| "               | 1701             | "       | "      | " 13          | 19 37                      | 35        | 2 15 "             | 18.0                    | 17.6 | 23.0       | 23.0 | "           | Good.     | Pl        |             |
| "               | 1708             | "       | "      | " 14          | 18 19                      | 23        | 52 "               | 20.0                    | 19.5 | 20.6       | 20.6 | .0016       | "         | H         |             |
| "               | 1716             | "       | "      | " 15          | 19 21                      | 22        | 2 02 "             | 14.5                    | 14.5 | 22.0       | 22.0 | .0015       | "         | H         |             |
| "               | 1727             | "       | "      | " 23          | 16 20                      | 42        | 5 E.               | 21.4                    | 20.6 | 24.6       | 24.6 | .0015       | Fair.     | Pl        |             |
| "               | 1730             | "       | "      | " 26          | 17 38                      | 24        | 58 W.              | 22.0                    | 21.5 | 23.6       | 23.6 | "           | Good.     | H         |             |
| "               | 1731             | "       | "      | " 26          | 18 07                      | 33        | 1 32 "             | 21.5                    | 21.5 | 29.5       | 29.5 | "           | No good.  | H         | Clouds 100m |
| "               | 1732             | "       | "      | " 27          | 18 15                      | 130       | 1 50 "             | 25.5                    | 24.0 | 29.5       | 29.5 | "           | "         | Pl        |             |
| "               | 1733             | "       | "      | " 27          | 20 10                      | 40        | 3 45 "             | 23.4                    | 23.0 | 29.8       | 29.7 | .0016       | Good.     | H         |             |
| "               | 1735             | "       | "      | " 28          | 17 46                      | 22        | 1 17 "             | 25.0                    | 24.0 | 29.7       | 29.7 | "           | "         | H         |             |
| "               | 1736             | "       | "      | " 28          | 18 08                      | 17        | 1 34 "             | 24.0                    | 23.0 | 29.7       | 29.7 | "           | "         | H         |             |
| "               | 1747             | "       | "      | " 30          | 17 47                      | 25        | 1 25 "             | 26.0                    | 25.0 | 31.1       | 31.0 | .0015       | "         | H         |             |



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1907. Sept. 12.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

# AQUILE 1038.

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 54.7334           |                          |                              |           | $\frac{1}{2}$  | 27.3601           |                          |                              |           |
| 1              | 53.9733           | 9818                     | 0120                         | +13.81    | 2              | 27.1906           |                          |                              |           |
| 2              | 53.1041           |                          |                              |           | $1\frac{1}{2}$ | 11.7684           | 8670                     | 0156                         | +11.68    |
| 2              | 45.2469           |                          |                              |           | 2              | 11.4086           |                          |                              |           |
| $1\frac{1}{2}$ | 45.2273           | 2540                     | 0153                         | 15.97     |                |                   |                          |                              |           |

Weighted mean..... +12.62  
*V<sub>a</sub>*..... -20.23  
*V<sub>d</sub>*..... -14  
 Curvature..... -28  
 Radial velocity..... -8.0

1907. Sept. 18.  
G. M. T. 14<sup>h</sup> 45<sup>m</sup>

# AQUILE 1050.

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0318           |                          |                              |           | 2              | 45.2738           |                          |                              |           |
| 1   | 72.8399           | 8031                     | 0156                         | -22.66    | $1\frac{1}{2}$ | 45.2130           | 2237                     | 0250                         | 26.17     |
| 2   | 72.4635           |                          |                              |           | $\frac{1}{2}$  | 27.3813           | 4591                     | 0374                         | -32.59    |
| 2   | 54.0294           |                          |                              |           | 2              | 27.2441           |                          |                              |           |

Weighted mean..... -26.06  
*V<sub>a</sub>*..... -22.14  
*V<sub>d</sub>*..... -14  
 Curvature..... -28  
 Radial velocity..... -48.6

1907. Sept. 18.  
G. M. T. 14<sup>h</sup> 45<sup>m</sup>

# AQUILE 1050.\*

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| $1\frac{1}{2}$ | 73.0040           |                          |                              |           | 2              | 53.1850           |                          |                              |           |
| 2              | 72.8394           | 8450                     | 0198                         | -28.73    | 2              | 45.2417           |                          |                              |           |
| 1              | 72.4318           |                          |                              |           | $1\frac{1}{2}$ | 45.1800           | 2119                     | 0268                         | 27.98     |
| 2              | 54.7082           |                          |                              |           | $\frac{1}{2}$  | 27.3593           | 3996                     | 0130                         | -11.28    |
| $\frac{1}{2}$  | 53.9314           | 9651                     | 0044                         | 5.06      | 2              | 27.2063           |                          |                              |           |

Weighted mean..... -22.43  
*V<sub>a</sub>*..... -22.14  
*V<sub>d</sub>*..... -14  
 Curvature..... -28

\* Check measurement.

Radial velocity..... -45.0

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1908. May 15.  
G. M. T. 20<sup>h</sup> 54<sup>m</sup>

# AQUILÆ 1533.

Observed by W. E. HARPER.  
Measured by J

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 54.7742           |                          |                              |           | 2              | 27.2579           |                          |                              |           |
| $\frac{1}{2}$  | 53.9093           | 8781                     | 0017                         | 105.54    | $1\frac{1}{2}$ | 15.3876           | 3776                     | 0956                         | -73.99    |
| 2              | 53.1421           |                          |                              |           | 2              | 15.4086           |                          |                              |           |
| 2              | 45.2974           |                          |                              |           | $\frac{1}{2}$  | 11.7542           | 7520                     | 0991                         | -74.45    |
| $1\frac{1}{2}$ | 45.1779           | 1541                     | 0846                         | -88.32    | 2              | 11.5091           |                          |                              |           |
| $\frac{1}{3}$  | 27.3612           | 3498                     | 0628                         | 54.51     |                |                   |                          |                              |           |

Weighted mean ..... -75.59  
 $V_a$  ..... +26.05  
 $V_d$  ..... +.96  
 Curvature ..... -.28

Radial velocity ..... -49.7

# AQUILÆ 1544.

1908. May 18.  
G. M. T. 20<sup>h</sup> 49<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 54.7267           |                          |                              |           | 2             | 45.2655           |                          |                              |           |
| $2\frac{1}{2}$ | 53.8990           | 9160                     | 0538                         | -61.92    | $\frac{1}{2}$ | 45.1692           | 1773                     | 0614                         | -64.10    |
| 2              | 53.0932           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... -62.30  
 $V_a$  ..... +25.50  
 $V_d$  ..... -.04  
 Curvature ..... -.28

Radial velocity ..... -37.0

# AQUILÆ 1576.

1908. June 3.  
G. M. T. 20<sup>h</sup> 35<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7369           |                          |                              |           | $\frac{3}{4}$ | 45.1970           | 1900                     | 0487                         | -50.84    |
| 2   | 53.8906           | 8976                     | 0722                         | -83.10    | 1             | 11.8670           | 7770                     | 0744                         | -55.72    |
| 2   | 53.1029           |                          |                              |           | 2             | 11.5975           |                          |                              |           |
| 2   | 45.2806           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... -69.34  
 $V_a$  ..... +21.62  
 $V_d$  ..... -.02  
 Curvature ..... -.28

Radial velocity ..... -48.0

9-10 EDWARD VII., A. 1910

 $\theta$  AQUILÆ 1583.1908, June 5,  
G. M. T. 9<sup>h</sup> 42<sup>m</sup>Observed by T. H. PARKER.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9955           |                          |                              |           | 2   | 45 2607           |                          |                              |           |
| 1   | 72 8212           | 8347                     | 0301                         | -43 68    | 1½  | 45 1648           | 1776                     | 0611                         | -63 79    |
| 2   | 72 4342           |                          |                              |           | 1   | 27 3467           | 3418                     | 0708                         | -61 45    |
| 2   | 54 7250           |                          |                              |           | 2   | 27 2518           |                          |                              |           |
| 2   | 53 9156           | 9287                     | 0411                         | -47 31    | 2   | 11 8084           | 7915                     | 0599                         | -44 87    |
| 2   | 53 1028           |                          |                              |           | 2   | 11 5245           |                          |                              |           |

Weighted mean..... -51 35

 $V_a$ ..... +20 91 $V_d$ ..... + 04

Curvature..... - 28

Radial velocity..... -30 7

 $\theta$  AQUILÆ 1604.1908, June 12,  
G. M. T. 19<sup>h</sup> 32<sup>m</sup>Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0175           |                          |                              |           | 2   | 45 2995           |                          |                              |           |
| 1½  | 72 8819           | 8436                     | 0212                         | -30 76    | 1   | 45 2281           | 2022                     | 0365                         | -38 11    |
| 2   | 72 4848           |                          |                              |           | 1   | 37 7627           | 7265                     | 0282                         | -27 21    |
| 2   | 57 8373           | 7895                     | 0373                         | -44 91    | 2   | 37 9955           |                          |                              |           |
| 1   | 57 7974           |                          |                              |           | 1   | 27 4133           | 3852                     | 0274                         | -23 78    |
| 2   | 54 7562           |                          |                              |           | 2   | 27 2746           |                          |                              |           |
| 2   | 53 9652           | 9492                     | 0206                         | -23 71    | 1   | 11 8637           | 8173                     | 0341                         | -25 54    |
| 2   | 53 1298           |                          |                              |           | 2   | 11 5542           |                          |                              |           |

Weighted mean..... -29 64

 $V_a$ ..... +18 58 $V_d$ ..... - 04

Curvature..... - 28

Radial velocity..... -11 4

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# AQUILAE 1605.

1908, June 12.  
G. M. T. 20<sup>h</sup> 15<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|---------------|-------------------|--------------------------|-----------------------|-----------|-----|-------------------|--------------------------|-----------------------|-----------|
| 2             | 72.9907           |                          |                       |           | 2   | 53.6714           |                          |                       |           |
| $\frac{1}{2}$ | 72.8128           | 8345                     | 0303                  | -43.96    | 2   | 45.2430           |                          |                       |           |
| 2             | 72.4181           |                          |                       |           | 1   | 45.1817           | 2124                     | 0263                  | -27.45    |
| 2             | 57.7935           |                          |                       |           | 2   | 43.5027           |                          |                       |           |
| 1             | 57.7576           | 7934                     | 0334                  | -40.21    | 1   | 27.3562           | 3619                     | 0507                  | -44.00    |
| 1             | 56.6375           |                          |                       |           | 2   | 27.2410           |                          |                       |           |
| 2             | 54.7059           |                          |                       |           | 1   | 11.7999           | 7969                     | 0545                  | -41.56    |
| 1             | 53.9117           | 9500                     | 0198                  | -22.78    | 2   | 11.5103           |                          |                       |           |

Weighted mean..... -32.99  
 $V_a$ ..... +18.58  
 $V_d$ ..... - .64  
 Curvature..... - .28  
 Radial velocity..... -14.7

# AQUILAE 1623.

1908, June 22.  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|----------------|-------------------|--------------------------|-----------------------|-----------|---------------|-------------------|--------------------------|-----------------------|-----------|
| 1              | 57.8274           |                          |                       |           | $\frac{1}{2}$ | 37.7445           | 7260                     | 0287                  | -27.67    |
| $\frac{1}{2}$  | 57.7977           | 7957                     | 0311                  | -37.44    | $\frac{1}{2}$ | 29.7998           | 7680                     | 0629                  | -55.92    |
| 2              | 54.7455           |                          |                       |           | 2             | 29.6306           |                          |                       |           |
| 2              | 53.9400           | 9377                     | 0321                  | -36.95    | 1             | 27.3906           | 3481                     | 0645                  | -55.98    |
| 2              | 53.1130           |                          |                       |           | 2             | 27.2891           |                          |                       |           |
| 2              | 45.2851           |                          |                       |           | 2             | 11.8445           | 7902                     | 0612                  | -58.39    |
| $1\frac{1}{2}$ | 45.2209           | 2094                     | 0293                  | -30.60    | 2             | 11.5615           |                          |                       |           |
| 2              | 37.9777           |                          |                       |           |               |                   |                          |                       |           |

Weighted mean..... -44.13  
 $V_a$ ..... +15.91  
 $V_d$ ..... + .04  
 Curvature..... - .28  
 Radial velocity..... -29.0

9-10 EDWARD VII., A. 1910

1908. June 22.  
G. M. T. 18° 35'

# AQUILE 1626.\*

Observed by T. H. PARRER.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|----------------|-------------------|--------------------------|-----------------------|-----------|---------------|-------------------|--------------------------|-----------------------|-----------|
| 1              | 57 8369           |                          |                       |           | $\frac{1}{2}$ | 37 7667           | 7262                     | 0383                  | -36° 92   |
| $\frac{1}{2}$  | 57 8165           | 8025                     | 0243                  | -29° 26   | $\frac{1}{2}$ | 29 8124           | 7624                     | 0685                  | -60° 90   |
| 2              | 54 7682           |                          |                       |           | 2             | 29 6441           |                          |                       |           |
| 2              | 53 9534           | 9294                     | 0404                  | -46° 50   | 1             | 27 4266           | 3746                     | 0380                  | -32° 98   |
| 2              | 53 1347           |                          |                       |           | 2             | 27 3062           |                          |                       |           |
| 2              | 45 3077           |                          |                       |           | 2             | 11 8604           | 7864                     | 0650                  | -48° 68   |
| $1\frac{1}{2}$ | 45 2463           | 2123                     | 0264                  | -27° 56   | 2             | 11 5823           |                          |                       |           |
| 2              | 38 9962           |                          |                       |           |               |                   |                          |                       |           |

Weighted mean..... -41° 03  
*V<sub>a</sub>*..... +15° 01  
*V<sub>d</sub>*..... + 04  
 Curvature..... - 28  
 Radial velocity..... -26° 3

\*Check measurement.

1908. June 24  
G. M. T. 19° 46"

@ AQUILE 1634.

Observed by W. E. HARPER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|---------------|-------------------|--------------------------|-----------------------|-----------|----------------|-------------------|--------------------------|-----------------------|-----------|
| 2             | 57 9245           |                          |                       |           | 1              | 37 8255           | 7200                     | 0347                  | -33° 45   |
| $\frac{1}{2}$ | 57 8639           | 7688                     | 0580                  | -69° 83   | 2              | 30 0385           |                          |                       |           |
| $\frac{1}{2}$ | 54 8105           |                          |                       |           | 1              | 29 8974           | 7819                     | 0490                  | -43° 56   |
| 3             | 54 0327           | 9347                     | 0351                  | -40° 40   | $1\frac{1}{2}$ | 27 4733           | 3561                     | 0565                  | -49° 04   |
| 2             | 53 2094           |                          |                       |           | 2              | 27 3638           |                          |                       |           |
| 2             | 45 3719           |                          |                       |           | $2\frac{1}{2}$ | 11 9231           | 8911                     | 0503                  | -37° 67   |
| 2             | 45 2924           | 1941                     | 0446                  | -46° 56   | 2              | 11 6292           |                          |                       |           |
| 2             | 38 0650           |                          |                       |           |                |                   |                          |                       |           |

Weighted mean..... -42° 95  
*V<sub>a</sub>*..... +14° 12  
*V<sub>d</sub>*..... - 06  
 Curvature..... - 28  
 Radial velocity..... -29° 2



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$\theta$  AQUILÆ 1643.

1908, June 26.  
G. M. T. 19<sup>h</sup> 42<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|-----|-------------------|--------------------------|-----------------------|-----------|-----|-------------------|--------------------------|-----------------------|-----------|
| 2   | 57 8751           |                          |                       |           | 2   | 38 0110           |                          |                       |           |
| 2   | 57 8285           | 7742                     | 0526                  | -63 33    | 2   | 37 7647           | 7131                     | 0416                  | -40 10    |
| 2   | 54 7850           |                          |                       |           | 1   | 27 4172           | 3588                     | 0538                  | -46 70    |
| 2   | 53 9798           | 9370                     | 0328                  | -37 75    | 2   | 27 3150           |                          |                       |           |
| 2   | 53 1545           |                          |                       |           | 3   | 11 8629           | 8040                     | 0474                  | -35 50    |
| 2   | 45 3226           |                          |                       |           | 2   | 11 5661           |                          |                       |           |
| 2   | 45 2498           | 2008                     | 0379                  | -39 57    |     |                   |                          |                       |           |

Weighted mean..... -42 90  
 $V_a$ ..... +13 22  
 $V_d$ ..... - 09  
 Curvature..... - 28  
 Radial velocity..... -30 0

$\theta$  AQUILÆ 1651.

1908, June 27.  
G. M. T. 18<sup>h</sup> 45<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|-----------------|-------------------|--------------------------|-----------------------|-----------|-----------------|-------------------|--------------------------|-----------------------|-----------|
| 2               | 57 8640           |                          |                       |           | 1               | 30 8717           | 8126                     | 0630                  | -56 57    |
| 1               | 57 8292           | 7946                     | 0322                  | -38 77    | 2               | 29 6583           |                          |                       |           |
| 2               | 54 7825           |                          |                       |           | 1               | 29 6105           | 5510                     | 0479                  | -42 53    |
| 2 $\frac{1}{2}$ | 53 9715           | 9320                     | 0378                  | -43 51    | 1 $\frac{1}{2}$ | 27 4256           | 3590                     | 0536                  | -46 52    |
| 2               | 53 1535           |                          |                       |           | 2               | 27 3135           |                          |                       |           |
| 2               | 45 3175           |                          |                       |           | 1 $\frac{1}{2}$ | 15 4903           | 4182                     | 0551                  | -42 65    |
| 1 $\frac{1}{2}$ | 45 2365           | 1926                     | 0461                  | -48 13    | 2               | 15 4707           |                          |                       |           |
| 2               | 38 0075           |                          |                       |           | 3               | 11 8646           | 7958                     | 0556                  | -41 64    |
| 1               | 37 7459           | 6973                     | 0554                  | -53 40    | 2               | 11 5760           |                          |                       |           |
| 2               | 30 9295           |                          |                       |           |                 |                   |                          |                       |           |

Weighted mean..... -45 06  
 $V_a$ ..... +12 83  
 $V_d$ ..... 00  
 Curvature..... - 28  
 Radial velocity..... -32 5

9-10 EDWARD VII. A. 1910

1908, July 3.  
G. M. T. 17<sup>h</sup> 30<sup>m</sup>

# AQUILE 1659.

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|----------------------|-------------------|--------------------------|-----------------------|-----------|-----|-------------------|--------------------------|-----------------------|-----------|
| 2                    | 54 6001           |                          |                       |           | 2   | 11 6263           | 11 7883                  | 0631                  | -47.26    |
| 2                    | 53 7884           | 53 9309                  | 0389                  | -44.77    | 2   | 11 3448           |                          |                       |           |
| 2                    | 52 9687           |                          |                       |           |     |                   |                          |                       |           |
| Weighted mean.....   |                   |                          |                       |           |     |                   |                          |                       | -46.01    |
| $V_a$ .....          |                   |                          |                       |           |     |                   |                          |                       | +10.32    |
| $V_d$ .....          |                   |                          |                       |           |     |                   |                          |                       | .00       |
| Curvature.....       |                   |                          |                       |           |     |                   |                          |                       | -.18      |
| Radial velocity..... |                   |                          |                       |           |     |                   |                          |                       | -35.9     |

# AQUILE 1679

1908, July 8.  
G. M. T. 18<sup>h</sup> 49<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revs. | Velocity. |
|----------------------|-------------------|--------------------------|-----------------------|-----------|-----|-------------------|--------------------------|-----------------------|-----------|
| 1                    | 73 1291           |                          |                       |           | 2   | 45 3990           |                          |                       |           |
| 1                    | 72 9478           | 72 8298                  | 0350                  | -50.78    | 1   | 45 3177           | 45 1923                  | 0464                  | -48.44    |
| 1                    | 72 5623           |                          |                       |           | 1   | 27 4959           | 27 3539                  | 0587                  | -50.95    |
| 2                    | 54 8610           |                          |                       |           | 2   | 27 3963           |                          |                       |           |
| 2                    | 54 0581           | 53 9390                  | 0308                  | -35.45    | 1½  | 11 9333           | 11 7803                  | 0711                  | -53.25    |
| 2                    | 53 2311           |                          |                       |           | 2   | 11 6602           |                          |                       |           |
| Weighted mean.....   |                   |                          |                       |           |     |                   |                          |                       | -46.30    |
| $V_a$ .....          |                   |                          |                       |           |     |                   |                          |                       | -8.05     |
| $V_d$ .....          |                   |                          |                       |           |     |                   |                          |                       | -.09      |
| Curvature.....       |                   |                          |                       |           |     |                   |                          |                       | -.28      |
| Radial velocity..... |                   |                          |                       |           |     |                   |                          |                       | -38.6     |

# AQUILE 1691.

1908, July 10.  
G. M. T. 19<sup>h</sup> 30<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 72 9970           |                          |                              |           | 1½  | 53 9308           | 53 8368                  | 0630                         | -37.98    |
| 2                    | 72 8227           | 72 8352                  | 0296                         | -42.94    | 2   | 53 1936           |                          |                              |           |
| 2                    | 72 4327           |                          |                              |           | 2   | 45 2729           |                          |                              |           |
| 2                    | 57 7960           |                          |                              |           | 2   | 45 1767           | 45 1777                  | 0610                         | -63.68    |
| 1                    | 57 7501           | 57 7831                  | 0463                         | -55.74    | ½   | 27 3741           | 27 3471                  | 0655                         | -56.85    |
| 2                    | 56 6372           |                          |                              |           | 2   | 27 2739           |                          |                              |           |
| 2                    | 54 7314           |                          |                              |           |     |                   |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | 48.88     |
| $V_a$ .....          |                   |                          |                              |           |     |                   |                          |                              | -7.14     |
| $V_d$ .....          |                   |                          |                              |           |     |                   |                          |                              | -.12      |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | -.28      |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | -42.1     |

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1908, July 10,  
G. M. T. 19<sup>h</sup> 30<sup>m</sup>

$\theta$  AQUILÆ 1691\*.

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1               | 73 0001           |                          |                              |           | 1 $\frac{1}{2}$ | 53 9446           | 9446                     | 0252                         | - 29 00   |
| 1 $\frac{1}{2}$ | 72 8210           | 8277                     | 0371                         | 53 83     | 2               | 53 1121           |                          |                              |           |
| 1               | 72 4443           |                          |                              |           | 2               | 45 2831           |                          |                              |           |
| 2               | 57 8282           |                          |                              |           | 1 $\frac{1}{2}$ | 45 1971           | 1874                     | 0513                         | - 53 56   |
| 1               | 57 7688           | 7700                     | 0568                         | 68 39     | 1 $\frac{1}{2}$ | 27 4088           | 3658                     | 0468                         | - 39 62   |
| 2               | 54 7417           |                          |                              |           | 2               | 27 2902           |                          |                              |           |

Weighted mean ..... - 47 79

$V_a$  ..... + 7 14

$V_d$  ..... - 12

Curvature ..... - 28

\* Check measurement.

Radial velocity ..... - 41 0

1908, July 11,  
G. M. T. 19<sup>h</sup> 10<sup>m</sup>

$\theta$  AQUILÆ 1696.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 8543           |                          |                              |           | 1 $\frac{1}{2}$ | 45 2351           | 1991                     | 0396                         | - 41 34   |
| 1   | 57 8215           | 7968                     | 0300                         | - 36 12   | 2               | 29 6333           |                          |                              |           |
| 2   | 54 7744           |                          |                              |           | 1               | 29 6020           | 5676                     | 0313                         | - 27 54   |
| 2   | 53 9587           | 9274                     | 0424                         | - 48 80   | 2               | 11 8235           | 7982                     | 0532                         | - 39 85   |
| 2   | 53 1422           |                          |                              |           | 2               | 11 5325           |                          |                              |           |
| 2   | 45 3096           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean ..... - 40 40

$V_a$  ..... + 6 60

$V_d$  ..... - 12

Curvature ..... - 28

Radial velocity ..... - 34 2

$\theta$  AQUILÆ 1704.

1908, July 13,  
G. M. T. 19<sup>h</sup> 37<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0441           |                          |                              |           | 2              | 53.1318           |                          |                              |           |
| $\frac{1}{2}$ | 72.8698           | 8565                     | 0083                         | -12.05    | 2              | 45.3027           |                          |                              |           |
| 1             | 72.4491           |                          |                              |           | 1              | 45.2546           | 2156                     | 0231                         | -24.12    |
| $\frac{1}{2}$ | 57.8483           |                          |                              |           | $\frac{1}{2}$  | 27.4155           | 3555                     | 0561                         | -48.69    |
| $\frac{1}{2}$ | 57.8073           | 7883                     | 0385                         | -46.35    | 2              | 27.3060           |                          |                              |           |
| $\frac{1}{2}$ | 54.7666           |                          |                              |           | $1\frac{1}{2}$ | 11.8718           | 7958                     | 0556                         | -41.64    |
| 2             | 53.9556           | 9296                     | 0402                         | -46.27    | 2              | 11.5838           |                          |                              |           |

Weighted mean. . . . . -38.78  
 $V_a$  . . . . . +5.77  
 $V_d$  . . . . . - .16  
 Curvature . . . . . - .28  
 Radial velocity . . . . . -33.5

$\theta$  AQUILÆ 1708.

1908, July 14,  
G. M. T. 18<sup>h</sup> 19<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 73.0051           |                          |                              |           | 2              | 45.2705           |                          |                              |           |
| 1   | 72.8307           | 8351                     | 0297                         | -43.09    | 2              | 45.2015           | 2045                     | 0342                         | -35.70    |
| 1   | 72.4410           |                          |                              |           | $1\frac{1}{2}$ | 27.3918           | 3786                     | 0430                         | -37.32    |
| 2   | 54.7316           |                          |                              |           | $\frac{1}{2}$  | 27.2622           |                          |                              |           |
| 2   | 53.9435           | 9505                     | 0193                         | -22.21    | 2              | 11.8489           | 8199                     | 0315                         | -23.58    |
| 2   | 53.1072           |                          |                              |           | 2              | 11.5364           |                          |                              |           |

Weighted mean . . . . . -30.83  
 $V_a$  . . . . . +5.34  
 $V_d$  . . . . . .00  
 Curvature . . . . . - .23  
 Radial velocity . . . . . -25.8

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1908, July 15.  
G. M. T. 19<sup>h</sup> 24<sup>m</sup>

$\theta$  AQUILÆ 1716.

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0426           |                          |                              |           | 2              | 45.3046           |                          |                              |           |
| $\frac{1}{2}$ | 72.8798           | .8475                    | .0173                        | -25.10    | 1              | 45.2469           | .2159                    | .0228                        | 23.80     |
| 1             | 72.4764           |                          |                              |           | 2              | 29.6384           |                          |                              |           |
|               | 57.8582           |                          |                              |           | $1\frac{1}{2}$ | 29.6106           | .5716                    | .0273                        | 24.22     |
|               | 57.8243           | .7943                    | .0313                        | 37.68     | $1\frac{1}{2}$ | 27.1356           | .3871                    | .0255                        | 22.15     |
| 2             | 54.7774           |                          |                              |           | 2              | 27.2951           |                          |                              |           |
| 2             | 53.9873           | .9543                    | .0155                        | 17.84     | $1\frac{1}{2}$ | 11.8697           | .8197                    | .0317                        | -23.74    |
| 2             | 53.1427           |                          |                              |           | 2              | 11.5523           |                          |                              |           |

Weighted mean..... -23.88  
 $V_a$ ..... +4.86  
 $V_d$ ..... - .16  
 Curvature..... - .28  
 Radial velocity..... -19.5

$\theta$  AQUILÆ 1727.

1908, July 25.  
G. M. T. 16<sup>h</sup> 29<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0229           |                          |                              |           | 2              | 45.2811           |                          |                              |           |
| 1   | 72.8498           | .8385                    | .0263                        | -38.16    | 2              | 45.2157           | .2082                    | .0305                        | 31.84     |
| 1   | 72.4507           |                          |                              |           | $\frac{1}{2}$  | 27.3982           | .3715                    | .0411                        | 35.67     |
| 2   | 54.7506           |                          |                              |           | 2              | 27.2733           |                          |                              |           |
| 2   | 53.9420           | .9323                    | .0375                        | 43.16     | $2\frac{1}{2}$ | 11.8282           | .8011                    | .0503                        | -37.67    |
| 2   | 53.1227           |                          |                              |           | 2              | 11.5343           |                          |                              |           |

Weighted mean..... -37.52  
 $V_a$ ..... + .25  
 $V_d$ ..... + .04  
 Curvature..... - .28  
 Radial velocity..... -37.5

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1908, July 26,  
G. M. T. 17<sup>h</sup> 38<sup>m</sup>

# AQUILAE 1730.

Observed by W. E. HARPER.  
Measured by J

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0205           |                          |                              |           | 2   | 45.2945           |                          |                              |           |
| 1   | 72.8350           | 8244                     | 0404                         | -58.62    | 1½  | 45.2203           | 1994                     | 0393                         | 41.02     |
| 1   | 72.4551           |                          |                              |           | 1   | 27.4096           | 3642                     | 0484                         | 42.01     |
| 1   | 57.8380           |                          |                              |           | 2   | 27.2920           |                          |                              |           |
| 1   | 54.7570           |                          |                              |           | 2   | 11.8372           | 8032                     | 0482                         | -36.10    |
| 2   | 53.9564           | 9427                     | 0271                         | 31.19     | 2   | 11.5612           |                          |                              |           |
| 2   | 53.1243           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... 38.20  
 $V_a$ ..... 24  
 $V_d$ ..... 11  
 Curvature..... 28  
 Radial velocity..... -38.8

# AQUILAE 1731.

1908, July 26,  
G. M. T. 18<sup>h</sup> 07<sup>m</sup>Observed by W. E. HARPER.  
Measured by J

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.8287           |                          |                              |           | 1½  | 45.1997           | 1980                     | 0407                         | 42.49     |
| 1   | 57.7975           | 7982                     | 0286                         | -41.50    | 1½  | 27.3970           | 3792                     | 0334                         | 29.00     |
| 1   | 54.7409           |                          |                              |           | 2   | 27.2644           |                          |                              |           |
| 1   | 53.9365           | 9368                     | 0330                         | 38.00     | 1½  | 11.8173           | 7869                     | 0645                         | -48.31    |
| 2   | 53.1122           |                          |                              |           | 2   | 11.5376           |                          |                              |           |
| 2   | 45.2753           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -39.83  
 $V_a$ ..... 24  
 $V_d$ ..... 11  
 Curvature..... 28  
 Radial velocity..... -40.5

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$\theta$  AQUILAE 1732.

1908, July 27,  
G. M. T. 18<sup>h</sup> 15<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.6860           |                          |                              |           | 1               | 45.0540           | 2035                     | 6352                         | 36.75     |
| 1   | 57.6422           | 7856                     | 0412                         | 49.60     | 2               | 29.4545           |                          |                              |           |
| 2   | 54.5924           |                          |                              |           | 1 $\frac{1}{2}$ | 29.4224           | 5668                     | 0321                         | 28.47     |
| 2   | 53.7915           | 9405                     | 0293                         | 33.72     | 1 $\frac{1}{4}$ | 11.6850           | 8415                     | 0099                         | -7.41     |
| 2   | 52.9636           |                          |                              |           | 2               | 11.3507           |                          |                              |           |
| 2   | 45.1239           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean..... -32.23  
 $V_a$ ..... -73  
 $V_d$ ..... -12  
 Curvature..... -28  
 Radial velocity..... -33.4

$\theta$  AQUILAE 1733.

1908, July 27,  
G. M. T. 20<sup>h</sup> 10<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.8173           |                          |                              |           | 1   | 53.9094           | 9241                     | 0457                         | -52.60    |
| 2   | 57.7872           | 7993                     | 0273                         | -32.87    | 2   | 53.1007           |                          |                              |           |
| 2   | 54.7239           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -39.45  
 $V_a$ ..... -73  
 $V_d$ ..... -24  
 Curvature..... -28  
 Radial velocity..... -40.7

$\theta$  AQUILAE 1735.

1908, July 28,  
G. M. T. 17<sup>h</sup> 49<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.7810           |                          |                              |           | 2               | 37.9067           |                          |                              |           |
| 1   | 57.7302           | 7786                     | 0482                         | -57.91    | 1 $\frac{1}{2}$ | 37.6760           | 7285                     | 0262                         | 25.26     |
| 2   | 54.6993           |                          |                              |           | 2               | 29.5479           |                          |                              |           |
| 2   | 53.8959           | 9391                     | 0307                         | 35.33     | 1               | 29.4960           | 5470                     | 0519                         | 46.14     |
| 2   | 53.0681           |                          |                              |           | 1 $\frac{1}{2}$ | 27.3178           | 3688                     | 0438                         | -38.02    |
| 2   | 45.2233           |                          |                              |           | 2               | 27.1956           |                          |                              |           |
| 1   | 45.1554           | 2057                     | 0330                         | 34.45     |                 |                   |                          |                              |           |

Weighted mean..... -40.13  
 $V_a$ ..... -1.20  
 $V_d$ ..... -10  
 Curvature..... -28  
 Radial velocity..... -42.7

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1908. July 28.  
G. M. T. 18<sup>h</sup> 08<sup>m</sup> $\theta$  AQUILÆ 1736.Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7938           |                          |                              |           | 2   | 37 9039           |                          |                              |           |
| 1½  | 53 9012           | 9418                     | 0280                         | -32.23    | ½   | 37 6815           | 7368                     | 0179                         | -17.25    |
| 2   | 53 0684           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... -28.48  
 $V_a$  ..... -1.20  
 $V_d$  ..... - .12  
 Curvature ..... - .28

Radial velocity. .... -30.1

1908. July 30.  
G. M. T. 17<sup>h</sup> 47<sup>m</sup> $\theta$  AQUILÆ 1747.Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0586           |                          |                              |           | 2   | 45 2720           |                          |                              |           |
| ½   | 72 8916           | 8438                     | 0210                         | -30.47    | 1½  | 45 1954           | 1970                     | 0417                         | 43.53     |
| 2   | 72 4899           |                          |                              |           | ⅓   | 27 3662           | 3783                     | 0343                         | 29.77     |
| 2   | 54 7537           |                          |                              |           | 2   | 27 2345           |                          |                              |           |
| 2   | 53 9640           | 9538                     | 0160                         | 18.42     | ½   | 11 7805           | 8237                     | 0287                         | -21.50    |
| 2   | 53 1210           |                          |                              |           | 2   | 11 4640           |                          |                              |           |

Weighted mean ..... -28.60  
 $V_a$  ..... -2.13  
 $V_d$  ..... - .10  
 Curvature ..... - .28

Radial velocity. .... -31.1

1908. July 31.  
G. M. T. 17<sup>h</sup> 52<sup>m</sup> $\theta$  AQUILÆ 1755.Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 9005           |                          |                              |           | 2   | 29 6870           |                          |                              |           |
| 1   | 57 8680           | 7968                     | 0300                         | -36.12    | 1   | 27 4678           | 3771                     | 0355                         | 30.81     |
| 2   | 45 3421           |                          |                              |           | 2   | 27 3373           |                          |                              |           |
| 1   | 45 2829           | 2144                     | 0243                         | 25.37     | 1   | 11 8987           | 8159                     | 0355                         | -26.59    |
| 1½  | 29 6625           | 5744                     | 0245                         | 21.78     | 2   | 11 3900           |                          |                              |           |

Weighted mean ..... -27.56  
 $V_a$  ..... -2.59  
 $V_d$  ..... - .11  
 Curvature ..... - .28

Radial velocity. .... -30.5



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1908, July 31.  
G. M. T. 18<sup>h</sup> 19<sup>m</sup>

# AQUILAE 1756.

Observed by W. L. HARPER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.1099           |                          |                              |           | 2             | 15.3718           |                          |                              |           |
| $\frac{1}{2}$ | 72.9433           | .8464                    | .0184                        | 26.70     | 2             | 45.3132           | .2150                    | .0237                        | 24.74     |
| 2             | 72.5395           |                          |                              |           | $\frac{1}{2}$ | 27.5107           | .3881                    | .0245                        | 21.27     |
| 2             | 54.8279           |                          |                              |           | 2             | 27.3692           |                          |                              |           |
| $\frac{1}{2}$ | 54.0425           | .9526                    | .0172                        | 19.80     | 2             | 11.9418           | .8239                    | .0275                        | -20.60    |
| 2             | 53.2057           |                          |                              |           | 2             | 11.6251           |                          |                              |           |

Weighted mean..... -23.42  
 $V_d$ ..... - 2.59  
 $V_r$ ..... - .15  
 Curvature..... - .28  
 Radial velocity..... -26.4

1908, Aug. 5.  
G. M. T. 14<sup>h</sup> 50<sup>m</sup>

# AQUILAE 1762.

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0445           |                          |                              |           | 2             | 37.9735           |                          |                              |           |
| $\frac{1}{2}$ | 72.9019           | .8689                    | .0041                        | + 5.94    | $\frac{1}{2}$ | 37.8169           | .8026                    | .0479                        | 46.17     |
| 2             | 72.4763           |                          |                              |           | $\frac{1}{2}$ | 30.9439           | .9214                    | .0458                        | 41.12     |
| 2             | 54.7639           |                          |                              |           | 2             | 30.8932           |                          |                              |           |
| 1             | 54.0333           | .0153                    | .0455                        | 52.37     | 1             | 27.4672           | .4477                    | .0351                        | 30.46     |
| 2             | 54.0467           |                          |                              |           | 2             | 27.2659           |                          |                              |           |
| 2             | 53.1283           |                          |                              |           | 1             | 11.9221           | .9161                    | .0647                        | +48.46    |
| 2             | 45.2915           |                          |                              |           | 2             | 11.5123           |                          |                              |           |
| $\frac{1}{2}$ | 45.2840           | .2661                    | .0274                        | 28.60     |               |                   |                          |                              |           |

Weighted mean..... +39.69  
 $V_d$ ..... - 4.91  
 $V_r$ ..... + .09  
 Curvature..... - .28  
 Radial velocity..... -34.6

1908, Aug. 5,  
G. M. T. 16<sup>h</sup> 29<sup>m</sup>

# AQUILÆ 1766.

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7555           |                          |                              |           | 2   | 37 9696           |                          |                              |           |
| 1½  | 54 0175           | 0058                     | 0360                         | -41.44    | 1   | 37 8146           | 8042                     | 0495                         | 47.72     |
| 2   | 53 1220           |                          |                              |           | 2   | 11 9212           | 9696                     | 0582                         | -43.59    |
| 2   | 45 2833           |                          |                              |           | 2   | 11 5188           |                          |                              |           |
| 1½  | 45 2691           | 2594                     | 0207                         | 21.61     |     |                   |                          |                              |           |

Weighted mean ..... - 38.25

$V_a$  ..... - 4.91

$V_d$  ..... .02

Curvature ..... .28

Radial velocity ..... - 33.0

# AQUILÆ 1767.

1908, Aug. 5,  
G. M. T. 17<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7650           |                          |                              |           | 1   | 37 7837           | 7738                     | 0191                         | 16.98     |
| 1   | 54 0152           | 9958                     | 0260                         | -29.93    | ½   | 27 4480           | 4226                     | 0100                         | 8.68      |
| 2   | 53 1277           |                          |                              |           | 2   | 27 2720           |                          |                              |           |
| 2   | 45 2725           | 2545                     | 0158                         | 16.50     | ½   | 11 9186           | 8968                     | 0454                         | +34.00    |
| 2   | 45 2916           |                          |                              |           | 2   | 11 5284           |                          |                              |           |
| 2   | 37 9791           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... +21.19

$V_a$  ..... - 4.91

$V_d$  ..... .09

Curvature ..... .28

Radial velocity ..... -15.9

# AQUILÆ 1769.

1908, Aug. 5,  
G. M. T. 18<sup>h</sup> 48<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0800           |                          |                              |           | 2   | 54 0263           | 9743                     | 0045                         | + 5.18    |
| ½   | 72 9310           | 8618                     | 0030                         | - 4.35    | 2   | 53 1625           |                          |                              |           |
| 2   | 72 5112           |                          |                              |           | 2   | 45 3224           |                          |                              |           |
| 2   | 54 7953           |                          |                              |           | 1   | 45 2968           | 2476                     | 0089                         | + 9.29    |

Weighted mean ..... + 5.00

$V_a$  ..... - 4.91

$V_d$  ..... .19

Curvature ..... .28

Radial velocity ..... - 0.4

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$\theta$  AQUILAE 1776.

1908, Aug. 7,  
G. M. T. 17<sup>h</sup>

Observed by T. H. PARKER,  
Measured by W. E. HARPER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 73 0105           |                          |                              |           | 2   | 53 1270           |                          |                              |           |
| 2 $\frac{1}{2}$      | 72 8287           | 8311                     | 0337                         | 48 90     | 2   | 45 2947           |                          |                              |           |
| 2                    | 72 4393           |                          |                              |           | 1   | 45 2297           | 1994                     | 0393                         | 41 03     |
| 2                    | 54 7527           |                          |                              |           | 2   | 11 8727           | 8100                     | 0414                         | 30 64     |
| 1 $\frac{1}{2}$      | 53 9542           | 9413                     | 0285                         | 32 80     | 2   | 11 5703           |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | -35.19    |
| $V_a$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 5 87    |
| $V_d$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 08      |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | - 28      |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | - 41 4    |

$\theta$  AQUILAE 1777.

1908, Aug. 7,  
G. M. T. 17<sup>h</sup> 45<sup>m</sup>

Observed by T. H. PARKER,  
Measured by W. E. HARPER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 73 0173           |                          |                              |           | 2               | 45 3157           |                          |                              |           |
| 2 $\frac{1}{2}$      | 72 8345           | 8281                     | 0367                         | 33 25     | 1               | 45 2536           | 2117                     | 0270                         | 28 19     |
| 2                    | 72 4482           |                          |                              |           | 1               | 27 4414           | 3756                     | 0370                         | 32 12     |
| 2                    | 57 8521           |                          |                              |           | 2               | 27 3125           |                          |                              |           |
| 1                    | 57 8257           | 8028                     | 0240                         | 28 90     | 1 $\frac{1}{2}$ | 11 9090           | 8208                     | 0306                         | 22 64     |
| 2                    | 54 7686           |                          |                              |           | 2               | 11 5960           |                          |                              |           |
| 1 $\frac{1}{2}$      | 53 9666           | 9371                     | 0327                         | 37 64     | 1               | 29 8450           | 7881                     | 0428                         | 38 05     |
| 2                    | 53 1442           |                          |                              |           | 2               | 29 6558           |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |                 |                   |                          |                              | -32 57    |
| $V_a$ .....          |                   |                          |                              |           |                 |                   |                          |                              | - 5 87    |
| $V_d$ .....          |                   |                          |                              |           |                 |                   |                          |                              | - 14      |
| Curvature.....       |                   |                          |                              |           |                 |                   |                          |                              | - 28      |
| Radial velocity..... |                   |                          |                              |           |                 |                   |                          |                              | - 38 9    |

$\theta$  AQUILAE 1789.

1908, Aug. 17,  
G. M. T. 18<sup>h</sup> 18<sup>m</sup>

Observed by W. E. HARPER,  
Measured by J

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1 $\frac{1}{2}$      | 57 8885           | 8148                     | 0120                         | 13 81     | 2   | 45 3395           |                          |                              |           |
| 2                    | 57 9031           |                          |                              |           | 1   | 45 2972           | 2313                     | 0074                         | 7 72      |
| 2                    | 54 8125           |                          |                              |           | 2   | 38 0187           |                          |                              |           |
| 2                    | 54 0320           | 9614                     | 0084                         | 9 67      | 1   | 37 8079           | 7484                     | 0063                         | 6 07      |
| 2                    | 53 1826           |                          |                              |           |     |                   |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | - 9 78    |
| $V_a$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 10 39   |
| $V_d$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 21      |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | - 28      |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | - 20 7    |

1908, A. 2, 17,  
G. M. T. 18<sup>m</sup> 18<sup>m</sup>

\* AQUILÆ 1789.

Observed by ) W. E. HARPER.  
Measured by )

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 57 8769           |                          |                              |           | 1   | 45 2667           | 2271                     | 0116                         | 12 11     |
| 2               | 57 8580           | 8105                     | 0163                         | -20 15    | 2   | 37 9966           |                          |                              |           |
| 2               | 54 7899           |                          |                              |           | 1   | 37 7900           | 7526                     | 0021                         | 2 02      |
| 2               | 54 0078           | 9618                     | 0080                         | 9 21      | 1   | 29 8666           | 8260                     | 0049                         | - 4 36    |
| 2               | 53 1557           |                          |                              |           | 2   | 29 6395           |                          |                              |           |
| 2               | 45 3130           |                          |                              |           |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | - 9 91    |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | -10 39    |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | - 21      |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | - 28      |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | -20 8     |

\* Inadvertently remeasured.

1908, Aug. 19,  
G. M. T. 16<sup>m</sup> 45<sup>m</sup>

\* AQUILÆ 1794.

Observed by ) W. E. HARPER.  
Measured by )

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 111 6998          |                          |                              |           | 2   | 68 7143           |                          |                              |           |
| 2               | 111 3210          | 1330                     | 0193                         | -11 19    | 2   | 63 3992           |                          |                              |           |
| 2               | 110 2983          |                          |                              |           | 4   | 61 2972           | 2159                     | 0286                         | 11 75     |
| 2               | 71 8920           |                          |                              |           | 2   | 60 3880           |                          |                              |           |
| 1               | 71 8568           | 8664                     | 0392                         | 17 29     | 2   | 36 0921           |                          |                              |           |
| 1               | 69 5153           | 5373                     | 0155                         | 6 73      | 1   | 35 9450           | 9631                     | 0427                         | -14 90    |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | -12 41    |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | -11 21    |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | - 12      |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | - 28      |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | -24 0     |

\* Plate made with three-prism spectrograph.

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$\theta$  AQUILE 1799.

1908. Aug. 20.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

Observed by W. E. HARPER.  
Measured by f

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 12  | 72.9899           |                          |                              |           | 2             | 45.2480           | 2614                     | 0257                         | +26.83    |
| 12  | 72.8610           | 8811                     | 0163                         | -23.65    | 2             | 37.9470           |                          |                              |           |
| 12  | 72.4241           |                          |                              |           | 1             | 37.7533           | 7655                     | 0168                         | +10.41    |
| 12  | 57.8022           |                          |                              |           | 1             | 29.6165           | 6164                     | 0175                         | +15.56    |
| 1   | 57.8095           | 8387                     | 0119                         | +14.33    | 2             | 29.5990           |                          |                              |           |
| 12  | 54.7204           |                          |                              |           | $\frac{1}{2}$ | 27.4145           | 4051                     | 0075                         | -6.51     |
| 12  | 53.9533           | 9751                     | 0053                         | +6.11     | $\frac{1}{2}$ | 27.2560           |                          |                              |           |
| 12  | 53.0898           |                          |                              |           | $\frac{1}{2}$ | 11.8457           | 8229                     | 0185                         | -13.90    |
| 12  | 45.2572           |                          |                              |           | 2             | 11.5300           |                          |                              |           |

Weighted mean ..... -12.45

$V_a$  ..... -11.63

$V_d$  ..... 00

Curvature ..... -28

Radial velocity ..... +0.4

$\theta$  AQUILE 1800.

1908. Aug. 20.  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by W. E. HARPER.  
Measured by f

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0033           |                          |                              |           | $1\frac{1}{2}$ | 45.2531           | 2537                     | 0150                         | +15.66    |
| 2   | 72.8582           | 8648                     | 0000                         | 0.00      | 1              | 27.4586           | 4290                     | 0164                         | +14.23    |
| 2   | 72.4383           |                          |                              |           | 2              | 27.2762           |                          |                              |           |
| 12  | 54.7375           |                          |                              |           | 2              | 11.9095           | 8700                     | 0186                         | +13.93    |
| 1   | 53.9710           | 9747                     | 0049                         | +5.64     | 1              | 59.8045           |                          |                              |           |
| 2   | 53.1090           |                          |                              |           | 1              | 59.6690           | 6736                     | 0009                         | -1.23     |
| 2   | 45.2729           |                          |                              |           |                |                   |                          |                              |           |

Weighted mean ..... -10.00

$V_a$  ..... -11.63

$V_d$  ..... .05

Curvature ..... -28

Radial velocity ..... -2.0

1908, Aug. 20,  
G. M. T. 16<sup>h</sup> 42<sup>m</sup>

# AQUILAE 1801.

Observed by }  
Measured by } W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7354           |                          |                              |           | 1   | 29 6294           | 6194                     | 0205                         | 18 24     |
| 2   | 53 9787           | 9881                     | 0183                         | 21 06     | 2   | 29 6095           |                          |                              |           |
| 2   | 53 0997           |                          |                              |           | 1   | 27 4557           | 4361                     | 0235                         | 20 39     |
| 2   | 45 2665           |                          |                              |           | 2   | 27 2662           |                          |                              |           |
| 1½  | 45 2453           | 2524                     | 0157                         | 14 30     | 2   | 11 8902           | 8614                     | 0100                         | + 7 49    |
| 2   | 29 9322           |                          |                              |           | 2   | 11 5362           |                          |                              |           |
| 1   | 29 8670           | 8575                     | 0266                         | 23 67     |     |                   |                          |                              |           |

Weighted mean..... +18 52  
 $V_a$ ..... -11 63  
 $V_d$ ..... - 12  
 Curvature..... - 28  
 Radial velocity..... - 6 5

1908, Aug. 21,  
G. M. T. 13<sup>h</sup> 57<sup>m</sup>

# AQUILAE 1807.

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0196           |                          |                              |           | ¾   | 45 3011           | 2689                     | 0302                         | 31 52     |
| ¼   | 72 9000           | 8880                     | 0232                         | - 33 66   | 2   | 29 6480           |                          |                              |           |
| 2   | 72 4635           |                          |                              |           | 1   | 29 9315           | 8830                     | 0521                         | 46 32     |
| 2   | 54 7685           |                          |                              |           | ¾   | 27 4940           | 4406                     | 0280                         | 24 30     |
| 1½  | 54 0400           | 0124                     | 0426                         | 49 03     | 2   | 27 3002           |                          |                              |           |
| 2   | 53 1406           |                          |                              |           | ¾   | 11 9607           | 8964                     | 0410                         | 30 71     |
| 2   | 45 3058           |                          |                              |           | 2   | 11 5717           |                          |                              |           |

Weighted mean..... +41 42  
 $V_a$ ..... -12 04  
 $V_d$ ..... - 11  
 Curvature..... - 28  
 Radial velocity..... - 28 7

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$\theta$  AQUILÆ 1808.

1908. Aug. 21.  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9966           | .....                    | .....                        | .....     | 2   | 45 2823           | .....                    | .....                        | .....     |
| 1   | 72 8700           | 8818                     | 0170                         | +24 67    | 1   | 45 2779           | 2692                     | 0305                         | 31 84     |
| 2   | 72 4343           | .....                    | .....                        | .....     | 2   | 37 9791           | .....                    | .....                        | .....     |
| 2   | 57 8783           | 8783                     | 0515                         | 62 00     | 1   | 37 8077           | 7978                     | 0431                         | 41 55     |
| 2   | 57 8294           | .....                    | .....                        | .....     | 1   | 27 4542           | 4226                     | 0100                         | 8 68      |
| 2   | 34 7475           | .....                    | .....                        | .....     | 2   | 27 2782           | .....                    | .....                        | .....     |
| 1   | 54 0150           | 0110                     | 0412                         | 47 42     | 1   | 11 9453           | 9014                     | 0500                         | +37 45    |
| 2   | 33 1145           | .....                    | .....                        | .....     | 2   | 11 5512           | .....                    | .....                        | .....     |

Weighted mean ..... +38 27  
 $V_a$  ..... -12 04  
 $V_d$  ..... + 06  
 Curvature ..... - 28  
 Radial velocity ..... +26 0

$\theta$  AQUILÆ 1810.

1908. Aug. 21.  
G. M. T. 15<sup>h</sup> 28<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7201           | .....                    | .....                        | .....     | 2     | 29 5981           | .....                    | .....                        | .....     |
| 3   | 53 9840           | 0054                     | 0356                         | +40 97    | 2     | 27 4505           | 4459                     | 0333                         | 28 90     |
| 2   | 53 0910           | .....                    | .....                        | .....     | 2     | 27 2512           | .....                    | .....                        | .....     |
| 2   | 45 2620           | .....                    | .....                        | .....     | 1     | 11 8967           | 8831                     | 0317                         | +23 74    |
| 2   | 45 2523           | 2659                     | 0272                         | 28 40     | 2     | 11 5218           | .....                    | .....                        | .....     |
| 1   | 29 8745           | 8753                     | 0414                         | 39 47     | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... -34 73  
 $V_a$  ..... -12 04  
 $V_d$  ..... - 02  
 Curvature ..... - 28  
 Radial velocity ..... +22 4

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 $\theta$  AQUILÆ 1811.1908. Aug. 22.  
G. M. T. 15<sup>h</sup> 29<sup>m</sup>Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9587           | .....                    | .....                        | .....     | 2   | 45.2600           | .....                    | .....                        | .....     |
| 2   | 72.8387           | 8901                     | 0253                         | +36.71    | 1   | 45.2775           | 2911                     | 0524                         | 54.70     |
| 2   | 72.3930           | .....                    | .....                        | .....     | 1   | 27.4871           | 4580                     | 0454                         | 39.43     |
| 2   | 54.7138           | .....                    | .....                        | .....     | 2   | 27.2762           | .....                    | .....                        | .....     |
| 2   | 53.9876           | 0134                     | 0436                         | 50.18     | 2   | 11.9679           | 9170                     | 0656                         | +49.13    |
| 2   | 53.0885           | .....                    | .....                        | .....     | 2   | 11.5587           | .....                    | .....                        | .....     |

Weighted mean..... +47.86  
 $V_a$ ..... -12.50  
 $V_d$ ..... -03  
 Curvature..... -28

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Radial velocity..... +35.0

 $\theta$  AQUILÆ 1812.1908. Aug. 22.  
G. M. T. 15<sup>h</sup> 56<sup>m</sup>Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9892           | .....                    | .....                        | .....     | 2   | 45.2531           | .....                    | .....                        | .....     |
| 2   | 72.8897           | 9116                     | 0468                         | +67.91    | 1   | 45.2633           | 2838                     | 0451                         | 47.08     |
| 2   | 72.4190           | .....                    | .....                        | .....     | 2   | 27.5378           | 4728                     | 0602                         | 52.25     |
| 2   | 54.7430           | .....                    | .....                        | .....     | 2   | 27.3121           | .....                    | .....                        | .....     |
| 1   | 54.0200           | 0182                     | 0484                         | 55.71     | 2   | 12.0073           | 9163                     | 0649                         | +48.61    |
| 2   | 53.1145           | .....                    | .....                        | .....     | 2   | 11.5988           | .....                    | .....                        | .....     |

Weighted mean..... +52.03  
 $V_a$ ..... -12.50  
 $V_d$ ..... -08  
 Curvature..... -28

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Radial velocity..... +39.1



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$\theta$  AQUILE 1813.

1908. Aug. 22.  
G. M. T. 16<sup>h</sup> 21<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9817           |                          |                              |           | 2              | 45 2804           |                          |                              |           |
| $\frac{1}{2}$ | 72 8487           | 8779                     | 0131                         | +19 01    | 1              | 45 2807           | 2739                     | 0352                         | 36 75     |
| 2             | 72 4145           |                          |                              |           | $\frac{1}{2}$  | 29 7215           | 6886                     | 0897                         | 79 74     |
| $\frac{1}{2}$ | 57 8665           | 8839                     | 0571                         | 68 75     | 2              | 29 6318           |                          |                              |           |
| $\frac{1}{2}$ | 57 8120           |                          |                              |           | $\frac{1}{2}$  | 27 4825           | 4387                     | 0221                         | 19 18     |
| 2             | 54 7342           |                          |                              |           | 2              | 27 2904           |                          |                              |           |
| 1             | 54 0636           | 0118                     | 0429                         | 48 34     | $2\frac{1}{2}$ | 11 9879           | 9218                     | 0794                         | +52 73    |
| 2             | 53 1022           |                          |                              |           | 2              | 11 5733           |                          |                              |           |

Weighted mean..... +47 73  
 $V_a$ ..... -12 50  
 $V_d$ ..... - 11  
 Curvature..... - 28

Radial velocity..... +34 8

$\theta$  AQUILE 1814.

1908. Aug. 23.  
G. M. T. 15<sup>h</sup> 48<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0102           |                          |                              |           | 2   | 53 1312           |                          |                              |           |
| $\frac{1}{2}$ | 72 8535           | 8541                     | 0103                         | -14 94    | 2   | 45 3009           |                          |                              |           |
| 2             | 72 4415           |                          |                              |           | 1   | 45 2574           | 2301                     | 0086                         | 8 98      |
| 2             | 57 8425           |                          |                              |           | 1   | 27 4527           | 3856                     | 0270                         | 23 44     |
| 1             | 57 8224           | 8093                     | 0175                         | 21 07     | 2   | 27 3137           |                          |                              |           |
| 2             | 54 7607           |                          |                              |           | 2   | 11 9226           | 8286                     | 0228                         | -17 08    |
| 2             | 53 9771           | 9581                     | 0117                         | 13 47     | 2   | 11 6012           |                          |                              |           |

Weighted mean..... -16 27  
 $V_a$ ..... -12 95  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... -29 6

*θ* AQUILÆ 1815.

1908. Aug. 23.  
G. M. T. 16<sup>h</sup> 18<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0307           |                          |                              |           | 1½  | 45 2666           | 2192                     | 0195                         | 20 36     |
| ½   | 72 8645           | 8438                     | 0210                         | 30 47     | 2   | 38 0157           |                          |                              |           |
| 2   | 72 4655           |                          |                              |           | ½   | 37 7910           | 7348                     | 0199                         | 19 18     |
| 2   | 57 8525           |                          |                              |           | 1   | 29 6320           | 5663                     | 0336                         | 20 87     |
| 1½  | 57 8167           | 7936                     | 0332                         | 39 97     | 2   | 29 6646           |                          |                              |           |
| 2   | 54 7766           |                          |                              |           | 2½  | 27 4726           | 4035                     | 0091                         | 7 99      |
| 1½  | 54 0057           | 9686                     | 0012                         | 1 38      | 2   | 27 3157           |                          |                              |           |
| 2   | 53 1516           |                          |                              |           | 2   | 11 9125           | 8329                     | 0185                         | -13 86    |
| 2   | 45 3210           |                          |                              |           | 2   | 11 5870           |                          |                              |           |

Weighted mean..... - 19 50  
*V<sub>a</sub>*..... - 12 95  
*V<sub>d</sub>*..... - 7 10  
 Curvature..... - 28  
 Radial velocity..... - 32 6

*θ* AQUILÆ 1822.

1908. Aug. 24.  
G. M. T. 16<sup>h</sup> 51<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0206           |                          |                              |           | 3   | 45 2872           |                          |                              |           |
| 1   | 72 8615           | 8595                     | 0143                         | -20 75    | 1½  | 45 2305           | 2169                     | 0218                         | 22 76     |
| 2   | 72 4567           |                          |                              |           | 2   | 37 9830           |                          |                              |           |
| 2   | 57 8371           |                          |                              |           | 1   | 37 7598           | 7360                     | 0187                         | 18 03     |
| 1   | 57 8167           | 8090                     | 0178                         | 21 43     | 1   | 27 4280           | 3884                     | 0232                         | 20 14     |
| 2   | 54 7477           |                          |                              |           | 2   | 27 2862           |                          |                              |           |
| 2   | 53 9567           | 9471                     | 0227                         | 26 13     | 2½  | 11 8689           | 8272                     | 0242                         | -18 12    |
| 2   | 53 1254           |                          |                              |           | 2   | 11 5489           |                          |                              |           |

Weighted mean..... - 21 20  
*V<sub>a</sub>*..... - 13 40  
*V<sub>d</sub>*..... - 16  
 Curvature..... - 23  
 Radial velocity..... - 35 0

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# AQUILAE 1835.

1908, Aug. 27.  
G. M. T. 14<sup>h</sup> 02<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73 0129           |                          |                              |           | 2             | 45 2808           |                          |                              |           |
| $\frac{1}{2}$ | 72 8466           | 8451                     | 0197                         | 28 58     | $\frac{1}{2}$ | 45 2153           | 2081                     | 0306                         | 31 95     |
| 1             | 72 4418           |                          |                              |           | 1             | 27 3961           | 3662                     | 0536                         | 45 42     |
| 2             | 51 7388           |                          |                              |           | 2             | 27 2768           |                          |                              |           |
| 1             | 53 9403           | 9413                     | 0285                         | 32 80     | 1             | 11 8524           | 8125                     | 0389                         | 29 14     |
| 2             | 53 1131           |                          |                              |           | 2             | 11 5472           |                          |                              |           |

Weighted mean . . . . . - 33 92  
 $V_a$  . . . . . - 14 56  
 $V_d$  . . . . . - .06  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 48 8

# AQUILAE 1864.

1908, Sept. 3.  
G. M. T. 16<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0322           |                          |                              |           | $\frac{1}{2}$ | 45 2772           | 2317                     | 0070                         | 7 33      |
| 1             | 72 8740           | 8526                     | 0122                         | 17 73     | 2             | 29 9972           |                          |                              |           |
| $\frac{2}{3}$ | 72 4635           |                          |                              |           | $\frac{1}{2}$ | 29 8930           | 8174                     | 0135                         | 12 08     |
| 2             | 57 8686           |                          |                              |           | 1             | 29 6557           | 5860                     | 0129                         | 11 49     |
| $\frac{1}{2}$ | 57 8351           | 7959                     | 0309                         | 37 26     | 2             | 29 6787           |                          |                              |           |
| 2             | 54 7801           |                          |                              |           | 1             | 27 4700           | 3816                     | 0310                         | 27 03     |
| $\frac{2}{3}$ | 54 0005           | 9616                     | 0082                         | 9 46      | 2             | 27 3353           |                          |                              |           |
| 2             | 53 1516           |                          |                              |           | $\frac{1}{2}$ | 11 9352           | 8254                     | 0260                         | 19 58     |
| 2             | 45 3191           |                          |                              |           | 2             | 11 6205           |                          |                              |           |

Weighted mean . . . . . - 14 96  
 $V_a$  . . . . . - 17 37  
 $V_d$  . . . . . - .16  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 32 8

$\theta$  AQUILÆ 1864.\*

1908, Sept. 3.  
G. M. T. 16<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 72 9854           | .....                    | .....                        | .....     | 2             | 45 2737           | .....                    | .....                        | .....     |
| $\frac{1}{3}$  | 72 8295           | 8541                     | 0107                         | -15 52    | 1             | 45 2348           | 2347                     | 0040                         | 4 16      |
| 2              | 72 4198           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 29 8500           | 8107                     | 0202                         | 17 80     |
| 2              | 57 8199           | .....                    | .....                        | .....     | 2             | 30 9097           | .....                    | .....                        | .....     |
| $\frac{1}{3}$  | 57 8027           | 8122                     | 0172                         | 20 70     | 1             | 29 6055           | 5660                     | 0181                         | 16 05     |
| 2              | 54 7576           | .....                    | .....                        | .....     | 1             | 11 8883           | 8258                     | 0256                         | -19 17    |
| $1\frac{1}{2}$ | 53 9573           | 9618                     | 0080                         | 9 20      | 2             | 11 5697           | .....                    | .....                        | .....     |
| 2              | 53 1065           | .....                    | .....                        | .....     | .....         | .....             | .....                    | .....                        | .....     |

Weighted mean..... -15 34  
 $V_a$ ..... -17 37  
 $V_d$ ..... - 16  
 Curvature..... - 28  
 Radial velocity..... -33 1

\* Independent measurement.

$\theta$  AQUILÆ 1875.

1908, Sept. 8.  
G. M. T. 12<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73 0022           | .....                    | .....                        | .....     | 2              | 45 2770           | .....                    | .....                        | .....     |
| $\frac{1}{3}$ | 72 8789           | 8850                     | 0202                         | +29 31    | $1\frac{1}{2}$ | 45 3101           | 3067                     | 0680                         | 70 99     |
| 1             | 72 4437           | .....                    | .....                        | .....     | 1              | 27 5014           | 4694                     | 0568                         | 49 34     |
| 2             | 54 7140           | .....                    | .....                        | .....     | 2              | 27 2778           | .....                    | .....                        | .....     |
| 1             | 54 0395           | 0356                     | 0658                         | 75 73     | 1              | 12 0038           | 9496                     | 0982                         | -73 55    |
| 2             | 53 1178           | .....                    | .....                        | .....     | 2              | 11 5614           | .....                    | .....                        | .....     |

Weighted mean..... +67 85  
 $V_a$ ..... 17 08  
 $V_d$ ..... - 09  
 Curvature..... - 28  
 Radial velocity..... +50 6

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$\theta$  AQUILÆ 1875\*.

1908. Sept. 8.  
G. M. T. 12<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7676           | .....                    | .....                        | .....     | 2   | 29.6453           | .....                    | .....                        | .....     |
| 2   | 54.0485           | .0218                    | .0520                        | +59.85    | 1½  | 29.7430           | .6966                    | .0977                        | 86.66     |
| 2   | 53.1396           | .....                    | .....                        | .....     | 1   | 12.0185           | .9417                    | .0903                        | +67.63    |
| 2   | 45.3024           | .....                    | .....                        | .....     | 2   | 11.5846           | .....                    | .....                        | .....     |
| 1½  | 45.3295           | .3007                    | .0620                        | 64.73     |     |                   |                          |                              |           |

Weighted mean..... +69.07  
 $V_a$ ..... -17.08  
 $V_d$ ..... +.09  
 Curvature..... -.28

\* Check measurement.

Radial velocity..... +51.8

$\theta$  AQUILÆ 1876.

1908. Sept. 8.  
G. M. T. 13<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0136           | .....                    | .....                        | .....     | 1½  | 45.3045           | .3014                    | .0627                        | 65.45     |
| ½   | 72.9175           | .9105                    | .0457                        | +66.31    | 1   | 27.5001           | .4706                    | .0580                        | 50.34     |
| 2   | 72.4645           | .....                    | .....                        | .....     | 2   | 27.2761           | .....                    | .....                        | .....     |
| 2   | 54.7428           | .....                    | .....                        | .....     | 1½  | 11.9869           | .9574                    | .0660                        | +79.39    |
| 1½  | 54.0359           | .0350                    | .0652                        | 75.04     | 2   | 11.5444           | .....                    | .....                        | .....     |
| 2   | 45.2767           | .....                    | .....                        | .....     |     |                   |                          |                              |           |

Weighted mean..... +68.88  
 $V_a$ ..... -17.08  
 $V_d$ ..... .00  
 Curvature..... -.28

Radial velocity..... +51.5

$\theta$  AQUILÆ 1878.

1908. Sept. 11.  
G. M. T. 15<sup>h</sup>

Observed by J. B. CANNON.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0192           | .....                    | .....                        | .....     | 2   | 45.2692           | .....                    | .....                        | .....     |
| ½   | 72.8480           | .8396                    | .0252                        | -36.56    | 1   | 45.2233           | .2277                    | .0110                        | 11.48     |
| 2   | 72.4503           | .....                    | .....                        | .....     | 1   | 27.3789           | .3712                    | .0414                        | 35.93     |
| 2   | 54.7399           | .....                    | .....                        | .....     | 2   | 27.2511           | .....                    | .....                        | .....     |
| 2   | 53.9497           | .9515                    | .0183                        | 21.06     | 1½  | 11.8400           | .8283                    | .0231                        | -17.30    |
| 2   | 53.1104           | .....                    | .....                        | .....     | 2   | 11.5249           | .....                    | .....                        | .....     |

Weighted mean..... -22.29  
 $V_a$ ..... -20.21  
 $V_d$ ..... -.09  
 Curvature..... -.28

Radial velocity..... -47.7

RECORD OF SPECTROGRAMS.  
OBSERVING RECORD AND DETAILED MEASURES OF MERCURIES.

P.—Plaskett,  
H.—Harpo,  
C.—Cannon,  
P.—Parker,  
T.—Tribble.

| Star.    | No. of Negative. | Camera. | Plate.   | Date.    | Middle of Exposure<br>G. M. T. | D. ration. | Hour Angle<br>at end. |       | TEMPERATURE<br>CENTIGRADE. |       |            |      | Slit<br>Width. | Seeing.    | Observer. | Remarks. |
|----------|------------------|---------|----------|----------|--------------------------------|------------|-----------------------|-------|----------------------------|-------|------------|------|----------------|------------|-----------|----------|
|          |                  |         |          |          |                                |            | h.                    | m.    | Room.                      |       | Prism Box. |      |                |            |           |          |
|          |                  |         |          |          |                                |            |                       |       | Begin.                     | End.  | Begin.     | End. |                |            |           |          |
| 1907.    |                  |         |          |          |                                |            |                       |       |                            |       |            |      |                |            |           |          |
| Mercuris | 786              | H.      | Steel 27 | May 24   | 18 25                          | 20         | 0                     | 46 W. | 8.5                        | 9.5   | 16.4       | 16.4 | .001           | Fair.      | P         |          |
| "        | 801              | "       | "        | " 31     | 17 38                          | 20         | 25                    | W.    | 12.7                       | 12.6  | 18.8       | 18.8 | .001           | Good.      | P         |          |
| "        | 810              | "       | "        | " 8      | 19 28                          | 30         | 45                    | W.    | 13.0                       | 13.0  | 16.9       | 16.8 | .001           | Good.      | P         |          |
| "        | 816              | "       | "        | " 10     | 17 47                          | 35         | 1                     | 20 W. | 13.1                       | 12.8  | 17.9       | 17.9 | .001           | Good.      | P         |          |
| "        | 827              | "       | "        | " 11     | 15 39                          | 26         | 55                    | E.    | 13.6                       | 13.5  | 19.1       | 19.1 | .001           | Fair.      | H         |          |
| "        | 838              | "       | "        | " 12     | 18 35                          | 30         | 2                     | 10 W. | 15.4                       | 15.2  | 19.0       | 18.9 | .0012          | Fair.      | P         |          |
| "        | 847              | "       | "        | " 13     | 18 25                          | 19         | 55                    | W.    | 19.0                       | 19.0  | 25.8       | 25.8 | .0015          | Good.      | H         |          |
| "        | 851              | "       | "        | " 14     | 17 43                          | 34         | 1                     | 30 W. | 20.5                       | 19.8  | 23.1       | 23.1 | .0012          | Good.      | P         |          |
| "        | 862              | "       | "        | " 20     | 16 37                          | 31         | 46                    | W.    | 21.5                       | 21.0  | 25.4       | 25.4 | .0012          | Good.      | H         |          |
| "        | 871              | "       | "        | " 21     | 18 10                          | 35         | 2                     | 25 W. | 23.1                       | 22.6  | 29.0       | 29.0 | .001           | Good.      | P         |          |
| "        | 881              | "       | "        | " 25     | 16 01                          | 28         | 30                    | W.    | 23.8                       | 23.8  | 27.3       | 27.3 | .0012          | Fair.      | H         |          |
| "        | 893              | "       | "        | " 27     | 16 32                          | 35         | 1                     | 10 W. | 20.9                       | 20.0  | 24.5       | 24.5 | .0012          | Fair.      | H         |          |
| "        | 913              | "       | "        | July 4   | 16 18                          | 40         | 1                     | 25 W. | 20.0                       | 19.5  | 26.6       | 26.4 | .0012          | Poor.      | H         |          |
| "        | 920              | "       | "        | " 8      | 16 00                          | 35         | 1                     | 30 W. | 21.2                       | 21.2  | 29.4       | 29.4 | .0012          | Fair.      | P         |          |
| "        | 928              | "       | "        | " 9      | 15 15                          | 38         | 40                    | W.    | 22.2                       | 22.2  | 24.8       | 24.8 | .0012          | Good.      | T         |          |
| "        | 937              | "       | "        | " 10     | 14 53                          | 70         | 40                    | W.    | 24.5                       | 23.6  | 24.7       | 24.6 | .0012          | Poor.      | P         |          |
| "        | 952              | "       | "        | " 18     | 16 10                          | 60         | 2                     | 22 W. | 22.5                       | 22.5  | 28.5       | 28.5 | .0014          | Hazy.      | H         |          |
| "        | 957              | "       | "        | " 20     | 16 39                          | 32         | 2                     | 45 W. | 18.6                       | 18.8  | 21.5       | 21.5 | .0012          | Good.      | P         |          |
| "        | 976              | "       | "        | Aug. 1   | 17 30                          | 50         | 4                     | 20 W. | 20.0                       | 20.0  | 24.8       | 24.8 | .0012          | Very lazy. | T         |          |
| "        | 979              | "       | "        | " 3      | 13 28                          | 34         | 5                     | 30 W. | 20.8                       | 20.3  | 24.1       | 24.0 | .0012          | Poor.      | P         |          |
| "        | 987              | "       | "        | " 6      | 17 53                          | 80         | 5                     | 13 W. | 19.1                       | 18.0  | 23.3       | 23.3 | .0013          | Fair.      | T         |          |
| "        | 1018             | "       | "        | " 22     | 15 49                          | 33         | 1                     | 15 W. | 18.5                       | 18.0  | 24.2       | 24.2 | .0014          | Fair.      | H         |          |
| "        | 1062             | "       | "        | Sept. 20 | 11 37                          | 45         | 1                     | 54 W. | 22.3                       | 22.3  | 22.9       | 22.9 | .0014          | Poor.      | H         |          |
| 1908.    |                  |         |          |          |                                |            |                       |       |                            |       |            |      |                |            |           |          |
| "        | 1391             | "       | "        | Mar. 9   | 20 50                          | 60         | 1                     | 31 E. | 12.5                       | 13.0  | 1.0        | 1.0  | .0013          | Good.      | H         |          |
| "        | 1403             | "       | "        | " 16     | 21 42                          | 50         | 16                    | E.    | 13.0                       | 13.5  | 2.3        | 2.3  | .0014          | Good.      | H         |          |
| "        | 1483             | "       | "        | Apr. 13  | 21 35                          | 60         | 1                     | 36 W. | - 0.5                      | - 1.5 | 8.0        | 8.0  | .0018          | Poor.      | H         |          |



RECORD OF SPECTROGRAMS—Concluded.

P.—Plakett.  
H.—Harper.  
C.—Cannon.  
P.—Parkes.  
T.—Tribble.

| Star.       | No. of Negative. | Camera. | Place.    | Date.  | Middle of Exposure<br>G. M. T. | Duration. | Hour-Angle<br>at end. |       | TEMPERATURE<br>CENTIGRADE. |      |                 |      | Slit<br>Width. | Seeing. | Observer. | Remarks. |  |
|-------------|------------------|---------|-----------|--------|--------------------------------|-----------|-----------------------|-------|----------------------------|------|-----------------|------|----------------|---------|-----------|----------|--|
|             |                  |         |           |        |                                |           | h.                    | m.    | Room.                      |      | Prism Box.      |      |                |         |           |          |  |
|             |                  |         |           |        |                                |           |                       |       | Begin-<br>ning.            | End. | Begin-<br>ning. | End. |                |         |           |          |  |
| Mercuris... | 1903             | H.      | Steed St. | 1908,  | h. m.                          | m.        | h.                    | m.    | 13.5                       | 12.5 | 19.0            | 18.8 | 0015           | Bad.    | H         |          |  |
|             | 1905             | "       | "         | Oct. 1 | 13                             | 60        | 4                     | 30 W. | 9.2                        | 8.0  | 13.2            | 13.1 | 0015           | Clear.  | P         |          |  |
|             | 1906             | "       | "         | "      | 12                             | 44        | 3                     | 40 W. | 8.0                        | 7.3  | 13.1            | 13.0 | 0015           | Good.   | P         |          |  |
|             | 1907             | "       | "         | "      | 13                             | 50        | 4                     | 10 W. | 9.7                        | 8.5  | 14.5            | 14.5 | 0015           | Hazy.   | P         |          |  |
|             | 1926             | "       | "         | "      | 14                             | 60        | 6                     | 25 W. | 5.9                        | 5.5  | 6.6             | 7.2  | 0016           | Good.   | P         |          |  |
|             | 1961             | "       | "         | "      | Nov. 13                        | 53        | 4                     | 32 W. | 3.5                        | 3.0  | 8.3             | 7.3  | 0015           | "       | H         |          |  |
|             | 1983             | "       | "         | "      | "                              | 10        | 45                    | 4     | 52 W.                      | 11.0 | 12.0            | 12.0 | 13.0           | 0016    | "         | H        |  |
|             | 1993             | "       | "         | "      | Dec. 2                         | 11        | 57                    | 6     | 15 W.                      | 7.5  | 8.2             | 2.0  | 2.0            | 0016    | Windy.    | C        |  |
|             | "                | 2253    | "         | "      | 1909,                          | 22        | 45                    | 2     | 12 E.                      | 19.0 | 18.0            | 5.3  | 5.1            | 0016    | Fair.     | H        |  |
|             |                  | 2261    | "         | "      | Feb. 8                         | 25        | 56                    | 1     | 15 E.                      | 18.0 | 19.0            | 5.1  | 5.0            | 0016    | "         | H        |  |
| 2305        |                  | "       | "         | "      | 21                             | 31        | 1                     | 45 E. | 7.8                        | 7.8  | 0.8             | 0.6  | 0016           | "       | C         |          |  |
| 2306        |                  | "       | "         | "      | 22                             | 36        | 00                    | 43 E. | 6.0                        | 7.5  | 0.6             | 0.6  | 0016           | "       | C         |          |  |
| 2327        |                  | "       | "         | Mar. 3 | 21                             | 12        | 75                    | 1     | 25 E.                      | 5.8  | 6.1             | 0.6  | 0.7            | 0016    | Poor.     | C        |  |
| 2328        |                  | "       | "         | "      | 3                              | 22        | 68                    | 3     | 25 E.                      | 6.4  | 6.4             | 0.7  | 0.7            | 0016    | "         | C        |  |
| 2370        |                  | "       | "         | "      | 13                             | 18        | 56                    | 30    | 10 E.                      | 2.0  | 1.9             | 3.0  | 2.9            | 002     | Fair.     | P        |  |
| 2371        |                  | "       | "         | "      | 15                             | 19        | 23                    | 24    | 20 E.                      | 1.9  | 2.0             | 2.9  | 2.8            | 002     | "         | P        |  |
| 2384        |                  | "       | "         | "      | "                              | 13        | 27                    | 21    | 20 E.                      | 5.0  | 0.8             | 0.8  | 1.2            | 002     | Good.     | H        |  |
| 2385        |                  | "       | "         | "      | 15                             | 20        | 00                    | 27    | 13 E.                      | 5.2  | 5.0             | 1.2  | 1.2            | 002     | "         | H        |  |
| 2454        | "                | "       | "         | "      | 20                             | 05        | 30                    | 1     | 00 E.                      | 1.0  | 0.6             | 0.8  | 0.8            | 002     | "         | C        |  |
| 2455        | "                | "       | "         | 31     | 20                             | 39        | 32                    | 25 E. | 0.6                        | 0.0  | 0.8             | 0.7  | 002            | "       | C         |          |  |



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1907. May 21.  
G. M. T. 18<sup>h</sup> 25<sup>m</sup>

ε HERCULIS 786.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2              | 73 9685           | 4891 134              |                        |                     |                              |           | 3   | 52 5955           | 4460 292              |                        |                     |                              |           |
| 1 <sub>2</sub> | 73 1420           | 4871 413              |                        |                     |                              |           | 3   | 47 6274           | 4379 348              |                        |                     |                              |           |
| 2              | 72 6821           | 4860 564              | 607                    | 527                 | 920                          | -56 76    | 2   | 45 0505           | 4339 626              | 714                    | 634                 | 920                          | -63 48    |
| 2              | 56 5256           | 4528 760              |                        |                     |                              |           | 3   | 44 1325           | 4325 827              |                        |                     |                              |           |
| 3              | 53 8061           | 4480 945              | 985                    | 400                 | 415                          | -27 76    |     |                   |                       |                        |                     |                              |           |

Weighted mean..... - 56 53  
 $V_a$ ..... + 1 45  
 $V_d$ ..... - 794  
 Curvature..... - 28  
 Radial velocity..... - 55 4

ε HERCULIS 801.

1907. May 31.  
G. M. T. 17<sup>h</sup> 38<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0174           |                          |                              |           | 1   | 53 9504           | 9078                     | 0620                         | 71 36     |
| 2   | 72 8193           | 8105                     | 0543                         | -78 79    | 2   | 53 1565           |                          |                              |           |
| 2   | 72 4559           |                          |                              |           | 2   | 45 2192           | 1557                     | 0830                         | -86 65    |
| 2   | 54 7825           |                          |                              |           | 2   | 45 3368           |                          |                              |           |

Weighted mean..... - 80 45  
 $V_a$ ..... - 68  
 $V_d$ ..... - 702  
 Curvature..... - 28  
 Radial velocity..... - 81 4

ε HERCULIS 810.

1907. June 8.  
G. M. T. 19<sup>h</sup> 28<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9982           |                          |                              |           | 3   | 53 9506           | 8942                     | 0756                         | -87 02    |
| 1   | 72 8130           | 8281                     | 0367                         | -53 25    | 2   | 53 1734           |                          |                              |           |
| 2   | 72 4367           |                          |                              |           | 2   | 45 3626           |                          |                              |           |
| 2   | 54 7931           |                          |                              |           | 1   | 45 2450           | 1556                     | 0831                         | -86 76    |

Weighted mean..... - 80 21  
 $V_a$ ..... - 3 00  
 $V_d$ ..... - 19  
 Curvature..... - 28  
 Radial velocity..... - 83 7

ε HERCULIS 816.

1907, June 10,  
G. M. T. 17<sup>h</sup> 47<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|--------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|---------------|-----------|
| 12              | 73 8797           | 4875 671              | .....                  | .....               | .....        | .....     | 12              | 53 2681           | 4470 617              | .....                  | .....               | .....         | .....     |
| 12 <sub>1</sub> | 72 9235           | 4865 085              | .....                  | .....               | .....        | .....     | 12 <sub>2</sub> | 45 2728           | 4341 820              | .....                  | .....               | .....         | .....     |
| 1               | 72 7904           | 4861 951              | 807                    | 527                 | 320          | +19 74    | 12 <sub>3</sub> | 45 2356           | 4341 256              | 594                    | 634                 | 040           | -2 76     |
| 2               | 54 3881           | 4489 915              | .....                  | .....               | .....        | .....     | 2               | 27 4999           | 4102 238              | 106                    | 890                 | 216           | -15 60    |
| 1               | 53 9850           | 4482 931              | 150                    | 400                 | 759          | +50 17    | 3               | 27 3170           | 4100 053              | .....                  | .....               | .....         | .....     |

Weighted mean, ..... -16 04  
 $V_a$  ..... -3 57  
 $V_d$  ..... -97  
 Curvature ..... -28  
 Radial velocity ..... +12 7

ε HERCULIS 827.

1907, June 11,  
G. M. T. 15<sup>h</sup> 39<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9503           | .....                    | .....                        | .....     | 1     | 54 0175           | 0116                     | 0448                         | -51 56    |
| 1   | 72 8122           | 8724                     | 0076                         | -11 02    | 3     | 45 3037           | .....                    | .....                        | .....     |
| 2   | 72 3825           | .....                    | .....                        | .....     | 3     | 45 2540           | 2237                     | 0150                         | -15 66    |
| 2   | 54 0317           | .....                    | .....                        | .....     | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean, ..... -21 90  
 $V_a$  ..... 3 86  
 $V_d$  ..... -97  
 Curvature ..... -28  
 Radial velocity, ..... +17 8

ε HERCULIS 838.

1907, June 12,  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 72 4986           | .....                    | .....                        | .....     | 2 <sub>1</sub> | 45 2585           | 1957                     | 0430                         | 44 89     |
| 1 <sub>1</sub> | 72 8160           | 8258                     | 0390                         | 56 53     | 2 <sub>2</sub> | 45 3356           | .....                    | .....                        | .....     |
| 2              | 72 4380           | .....                    | .....                        | .....     | 1              | 27 4375           | 3116                     | 1010                         | -87 67    |
| 2              | 54 0675           | .....                    | .....                        | .....     | 2              | 27 3726           | .....                    | .....                        | .....     |
| 2              | 53 9500           | 9113                     | 0585                         | 67 33     | .....          | .....             | .....                    | .....                        | .....     |

Weighted mean, ..... -54 93  
 $V_a$  ..... -4 15  
 $V_d$  ..... -14  
 Curvature ..... -28  
 Radial velocity, ..... -59 5

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1907, June 12,  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

ε HERCULIS 838.

Observed by J. S. PLASKETT,  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 72 9608           |                          |                              |           | 1   | 45 2100           | 1853                     | 0534                         | 55 74     |
| 1   | 72 7742           | 7756                     | 0392                         | 56 87     | 2   | 43 5655           |                          |                              |           |
| 1½  | 72 3915           |                          |                              |           | 1½  | 27 4911           | 3175                     | 0651                         | 82 54     |
| 2   | 45 2982           |                          |                              |           | 2   | 27 33 3           |                          |                              |           |

Weighted mean..... 61 55  
 $V_a$ ..... 4 15  
 $V_d$ ..... 14  
 Curvature..... 28

Radial velocity..... 66 1

The mean of the two measurements, 61 7 used.

ε HERCULIS 847.

1907, June 13,  
G. M. T. 18<sup>h</sup> 25<sup>m</sup>

Observed by W. E. HARPER,  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7738           |                          |                              |           | 2   | 45 3226           |                          |                              |           |
| 2   | 53 9268           | 8948                     | 0750                         | 86 32     | 2   | 45 1962           | 1472                     | 0915                         | 95 52     |
| 2   | 53 1442           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... 90 87  
 $V_a$ ..... 4 43  
 $V_d$ ..... 16  
 Curvature..... 28

Radial velocity..... 95 7

ε HERCULIS 847.

1907, June 13,  
G. M. T. 18<sup>h</sup> 25<sup>m</sup>

Observed by W. E. HARPER,  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9662           |                          |                              |           | 1   | 52 2373           |                          |                              |           |
| ½   | 72 7752           | 8186                     | 0462                         | 67 03     | 2   | 48 7615           |                          |                              |           |
| 1   | 72 4080           |                          |                              |           | ½   | 45 2105           | 2068                     | 0319                         | 33 30     |
| 1   | 54 0198           |                          |                              |           | 1   | 45 2774           |                          |                              |           |
| 1   | 53 8890           | 8990                     | 0708                         | 81 48     |     |                   |                          |                              |           |

Weighted mean..... 65 82  
 $V_a$ ..... 4 43  
 $V_d$ ..... 16  
 Curvature..... 28

Radial velocity..... 70 7

Mean of two measurements, 83 2 used.

ε HERCULIS 851.

1907. June 14.  
G. M. T. 17<sup>h</sup> 43<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Measured Wave Length. | Normal wave length. | Displacement. | Velocity. | Wt. | Mean of Settings. | Measured Wave Length. | Normal wave length. | Displacement. | Velocity. |
|-----|-------------------|-----------------------|---------------------|---------------|-----------|-----|-------------------|-----------------------|---------------------|---------------|-----------|
| 2   | 73.3997           | 4875.675              |                     |               |           | 1½  | 53.9475           | 4482.744              | 400                 | 344           | +23.74    |
| 1½  | 72.9468           | 4864.956              |                     |               |           | 2   | 45.2453           | 4341.337              |                     |               |           |
| 1   | 72.8165           | 4861.887              | .527                | .360          | +22.21    | 1½  | 45.2036           | 4340.534              | .634                | .100          | - 6.90    |
| 1   | 72.3854           | 4851.790              |                     |               |           | 1   | 27.4152           | 4101.900              | .890                | .010          | + 0.73    |
| 1   | 53.9856           | 4482.656              |                     |               |           | 2   | 27.2529           | 4099.650              |                     |               |           |

Weighted mean..... + 9.64  
 $V_a$ ..... - 4.72  
 $V_d$ ..... - .09  
 Curvature..... - .28

Radial velocity..... + 4.5

ε HERCULIS 851.

1907. June 14.  
G. M. T. 17<sup>h</sup> 43<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 73.0227           |                          |                              |           | 1   | 53.1210           |                          |                              |           |
| 1   | 72.8756           | .8898                    | .0250                        | - 36.27   | ½   | 45.2536           | .2267                    | .0120                        | - 12.52   |
| ½   | 72.4630           |                          |                              |           | 2   | 45.3006           |                          |                              |           |
| 1   | 54.7568           |                          |                              |           | 2   | 27.2977           |                          |                              |           |
| 1   | 54.0085           | .9991                    | .0293                        | - 33.72   | 1   | 27.4617           | .4108                    | .0018                        | - 1.56    |

Weighted mean..... + 17.76  
 $V_a$ ..... - 4.72  
 $V_d$ ..... - .09  
 Curvature..... - .28

The mean of two measurements, +7.0 used.

Radial velocity..... - 12.7

ε HERCULIS 862.

1907. June 20.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1½  | 72.9908           |                          |                              |           | 2   | 53.1120           |                          |                              |           |
| 2   | 72.4301           |                          |                              |           | 2   | 45.2676           |                          |                              |           |
| 1   | 72.8461           | .8644                    | .0004                        | - 0.29    | 1   | 45.1917           | .1977                    | .0410                        | - 42.79   |
| 2   | 54.7464           |                          |                              |           | 2   | 27.2746           |                          |                              |           |
| ½   | 53.9312           | .9290                    | .0408                        | - 46.96   | 4   | 27.3742           | .3462                    | .0764                        | - 57.70   |

Weighted mean..... - 31.26  
 $V_a$ ..... - 6.33  
 $V_d$ ..... - .07  
 Curvature..... - .28

Radial velocity..... - 37.9

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$\epsilon$  HERCULIS 862.

1907. June 20.  
G. M. T. 16<sup>h</sup> 37<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 73.0166           |                          |                              |           | 1   | 45.2182           | .1950                    | .0437                        | 45.62     |
| 1   | 72.8604           | .8527                    | .0121                        | -17.55    | 2   | 43.5599           |                          |                              |           |
| 2   | 72.4557           |                          |                              |           | 1   | 27.4358           | .3833                    | .0293                        | -25.43    |
| 2   | 45.2969           |                          |                              |           | 2   | 27.2991           |                          |                              |           |

Weighted mean..... -27.53  
 $V_a$ ..... - 6.33  
 $V_d$ ..... - .07  
 Curvature..... - 28  
 Radial velocity..... -34.2

Mean of measurements, -34.5 used.

$\epsilon$  HERCULIS 871.

1907. June 21.  
G. M. T. 18<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. N. FRIBBLE.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1 $\frac{1}{2}$ | 72.3582           |                          |                              |           | 1 $\frac{1}{2}$ | 45.1420           | .1655                    | .0732                        | 76.39     |
| 2               | 72.3957           |                          |                              |           | 1 $\frac{1}{2}$ | 27.2546           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72.7847           | .8357                    | .0291                        | -42.22    | 1 $\frac{1}{2}$ | 27.3658           | .3578                    | .0641                        | -55.63    |
| 2               | 45.2501           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean..... -58.78  
 $V_a$ ..... - 6.49  
 $V_d$ ..... - .19  
 Curvature..... - 28  
 Radial velocity..... -65.7

$\epsilon$  HERCULIS 881.

1907 June 25.  
G. M. T. 16<sup>h</sup> 04<sup>m</sup>

Observed by W. E. HARPER.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 49.4200           |                          |                              |           | 1 $\frac{1}{2}$ | 27.3185           | .3189                    | .1030                        | -89.40    |
| 1   | 45.2146           | .1775                    | .0612                        | -63.89    | 1               | 27.2462           |                          |                              |           |
| 2   | 44.2931           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean..... -72.40  
 $V_a$ ..... - 7.64  
 $V_d$ ..... - .04  
 Curvature..... - 28  
 Radial velocity..... -80.4

ε HERCULIS 893.

1907, June 27.  
G. M. T. 16<sup>h</sup> 32<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1½  | 73.2721           |                          |                              |           | 1   | 53.9786           | .9741                    | .0043                        | 4.95      |
| 2   | 72.9960           |                          |                              |           | 2   | 45.2810           |                          |                              |           |
| 1   | 72.8555           | .8745                    | .0097                        | -14.07    | ½   | 45.2918           | .2843                    | .0456                        | +47.59    |
| 2   | 54.0335           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -12.64  
 $V_a$ ..... -8.22  
 $V_d$ ..... -11  
 Curvature..... -28  
 Radial velocity..... +4.0

ε HERCULIS 913.

1907, July 4.  
G. M. T. 16<sup>h</sup> 18<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.0216           |                          |                              |           | 2   | 45.2683           |                          |                              |           |
| 2   | 53.9485           | .9557                    | .0141                        | 16.22     |     |                   |                          |                              |           |

Weighted mean..... -16.22  
 $V_a$ ..... -9.98  
 $V_d$ ..... -14  
 Curvature..... -28  
 Radial velocity..... -26.6

ε HERCULIS 920.

1907, July 8.  
G. M. T. 16<sup>h</sup>

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9265           |                          |                              |           | 2   | 45.2319           |                          |                              |           |
| 2   | 72.3632           |                          |                              |           | 1   | 45.1886           | .2403                    | .0084                        | 8.79      |
| 1½  | 72.7804           | .8172                    | .0015                        | -2.17     | 2   | 27.2471           |                          |                              |           |
| 1½  | 53.9754           |                          |                              |           | ½   | 27.4015           | .4763                    | .0202                        | -17.60    |
| ½   | 53.9156           | .9556                    | .0010                        | -1.15     |     |                   |                          |                              |           |

Weighted mean..... -6.12  
 $V_a$ ..... -10.92  
 $V_d$ ..... -14  
 Curvature..... -28  
 Radial velocity..... -17.5

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ε HERCULIS 928.

1907. July 9.  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1½  | 54.0232           |                          |                              |           | 1   | 45.2855           | 2775                     | 0388                         | 49.90     |
| 1½  | 54.0319           | 0375                     | 0677                         | -77.91    | 1½  | 30.9135           |                          |                              |           |
| 2   | 45.2815           |                          |                              |           | 1   | 29.6773           | 6312                     | 0501                         | +44.42    |

Weighted mean ..... +53.31  
*V<sub>a</sub>* ..... -11.26  
*V<sub>d</sub>* ..... -11  
 Curvature ..... -28  
 Radial velocity ..... +41.6

ε HERCULIS 928.\*

1907. July 9.  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9585           |                          |                              |           | 2   | 53.9874           |                          |                              |           |
| 1½  | 72.8250           | 8764                     | 0116                         | +15.83    | ½   | 53.9415           | 9829                     | 0131                         | +15.08    |
| 1   | 72.3931           |                          |                              |           | 2   | 45.2441           |                          |                              |           |
| ½   | 57.8595           | 8969                     | 0700                         | [-84.28]  | 1½  | 45.2136           | 2431                     | 0044                         | +3.82     |
| 1   | 57.7826           |                          |                              |           | 2   | 29.6396           | 6406                     | 0417                         | +37.00    |
| ½   | 57.0674           | 7048                     | 1220                         | [-134.48] | 2   | 29.5979           |                          |                              |           |

Weighted mean ..... +20.60  
*V<sub>a</sub>* ..... -11.26  
*V<sub>d</sub>* ..... -11  
 Curvature ..... -28  
 Radial velocity ..... +9.0

\* This result used.

ε HERCULIS 937.

1907. July 10.  
G. M. T. 14<sup>h</sup> 55<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 72.9735           |                          |                              |           | 1   | 45.2284           | 2288                     | 0199                         | -20.83    |
| 1   | 72.8361           | 8261                     | 0054                         | +7.84     | 2   | 27.2965           |                          |                              |           |
| 2   | 45.2832           |                          |                              |           | ½   | 27.4291           | 4545                     | 0420                         | -36.60    |

Weighted mean ..... -20.86  
*V<sub>a</sub>* ..... -11.49  
*V<sub>d</sub>* ..... -09  
 Curvature ..... -28  
 Radial velocity ..... -32.7

HERCULIS 937.

1907. July 10.  
G. M. T. 14<sup>h</sup> 55<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 54 6678           |                          |                              |           | 2   | 45 2121           |                          |                              |           |
| 1   | 53 8654           | 9382                     | 0316                         | -36 37    | 1   | 45 1485           | 2100                     | 0287                         | -29 96    |
| 1   | 53 0405           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -33 16  
 $V_a$ ..... -11 49  
 $V_d$ ..... - 09  
 Curvature..... - 28

Radial velocity..... -45 0

Mean of measurements, -39<sup>o</sup> used.

HERCULIS 952.

1907. July 18.  
G. M. T. 16<sup>h</sup> 10<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9883           |                          |                              |           | $\frac{1}{2}$ | 53 9283           | 9333                     | 0365                         | 42 01     |
| 2   | 72 4271           |                          |                              |           | 2             | 45 2698           |                          |                              |           |
| 1   | 72 8008           | 8208                     | 0440                         | -63 85    | 1             | 45 2109           | 2147                     | 0240                         | -25 05    |
| 2   | 54 0238           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean..... -43 96  
 $V_a$ ..... -13 18  
 $V_d$ ..... - 19  
 Curvature..... - 28

Radial velocity..... -57 6

HERCULIS 957.

1907. July 29.  
G. M. T. 16<sup>h</sup> 39<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9599           |                          |                              |           | 2             | 45 2827           |                          |                              |           |
| 2   | 72 3852           |                          |                              |           | 1             | 45 2473           | 2482                     | 0000                         | 0 00      |
| 1   | 72 8265           | 8315                     | 0128                         | +18 31    | 2             | 27 3141           |                          |                              |           |
| 2   | 54 0154           |                          |                              |           | $\frac{1}{2}$ | 27 5080           | 5158                     | 0193                         | +16 82    |
| 1   | 53 9642           | 9642                     | 0076                         | + 8 77    |               |                   |                          |                              |           |

Weighted mean..... +10 15  
 $V_a$ ..... -13 57  
 $V_d$ ..... - 19  
 Curvature..... - 28

Radial velocity..... - 3 9



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ε HERCULIS 976.

1907, Aug. 1.  
G. M. T. 17<sup>h</sup> 20<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0008           |                          |                              |           | 2             | 45 2806           |                          |                              |           |
| $\frac{1}{2}$ | 72 8353           | 8443                     | 0205                         | -29 74    | 1             | 45 2454           | 2384                     | 0003                         | 0 00      |
| 2             | 54 0320           |                          |                              |           | 2             | 27 2821           |                          |                              |           |
| 2             | 53 9827           | 9595                     | 0103                         | 11 85     | $\frac{1}{2}$ | 27 4465           | 4110                     | 0109                         | 0 46      |

Weighted mean ..... - 10 79  
 $V_a$  ..... - 15 51  
 $V_d$  ..... - 27  
 Curvature ..... - 28  
 Radial velocity ..... - 26 8

ε HERCULIS 979.\*

1907, Aug. 3.  
G. M. T. 13<sup>h</sup> 28<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by TRIBBLE & HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |         |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|---------|
| 2             | 72 9868           |                          |                              |           | $\frac{1}{2}$  | 27 4924           | 4509                     | 0290                         | +25 17    |         |
| $\frac{1}{2}$ | 72 8763           | 8953                     | 0305                         | +44 26    | 2              | 54 7430           |                          |                              |           |         |
| 2             | 54 0237           |                          |                              |           | $1\frac{1}{2}$ | 54 0280           | 0278                     | 0620                         | +71 36    |         |
| 2             | 54 0309           | 0360                     | 0662                         | +76 19    | Centre         | 53 9587           | 9535                     | 0163                         | +18 76    |         |
| 2             | 54 7369           |                          |                              |           |                | $\frac{1}{2}$     | 53 8760                  | 8758                         | 0940      | -108 79 |
| 1             | 45 2775           |                          |                              |           |                | 2                 | 53 1113                  |                              |           | violet. |
| 2             | 45 2820           | 2780                     | 0393                         | +41 08    |                |                   |                          |                              |           |         |
| 2             | 27 2883           |                          |                              |           |                |                   |                          |                              |           |         |

\*Plate not used in the results.

ε HERCULIS 987.

1907, Aug. 6.  
G. M. T. 17<sup>h</sup> 35<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 6897           |                          |                              |           | 2   | 44 9542           |                          |                              |           |
| $\frac{1}{2}$ | 72 5573           | 7843                     | 0122                         | +17 75    | 1   | 44 9849           | 2833                     | 0244                         | +25 63    |

Weighted mean ..... +22 96  
 $V_a$  ..... -16 16  
 $V_d$  ..... - 28  
 Curvature ..... - 28  
 Radial velocity ..... +6 2

ε HERCULIS 1018.

1907. Aug. 22.  
G. M. T. 10<sup>h</sup> 49<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.0698           |                          |                              |           | 2             | 45.2977           |                          |                              |           |
| 1   | 54.0506           | .0156                    | .0458                        | -52.71    | $\frac{1}{2}$ | 45.3014           | .2774                    | .0387                        | +40.39    |

Weighted mean ..... +48.60  
 $V_a$  ..... -17.45  
 $V_d$  ..... -.27  
 Curvature..... -.28  
 Radial velocity..... +30.6

ε HERCULIS 1062.

1907. Sept. 20.  
G. M. T. 14<sup>h</sup> 37<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.0379           |                          |                              |           | 2   | 45.2630           |                          |                              |           |
| 1   | 53.9738           | .0647                    | .0651                        | -5.86     | 1   | 45.2412           | .2512                    | .0125                        | -13.04    |

Weighted mean..... +3.59  
 $V_a$  ..... -5.90  
 $V_d$  ..... -.28  
 Curvature..... -.28  
 Radial velocity..... -2.9

ε HERCULIS 1391.

1908. March 9.  
G. M. T. 20<sup>h</sup> 50<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7533           |                          |                              |           | $\frac{1}{3}$ | 27.3570           | .3650                    | .0566                        | 49.13     |
| 2   | 53.9358           | .9253                    | .0445                        | -51.22    | 2             | 27.2385           |                          |                              |           |
| 2   | 53.1215           |                          |                              |           | $\frac{1}{3}$ | 11.7667           | .7897                    | .0617                        | -46.21    |
| 2   | 45.2735           |                          |                              |           | 2             | 11.4840           |                          |                              |           |
| 1   | 45.2060           | .2061                    | .0326                        | 34.03     |               |                   |                          |                              |           |

Weighted mean ..... -46.03  
 $V_a$  ..... +17.56  
 $V_d$  ..... .14  
 Curvature..... -.28  
 Radial velocity..... -28.6

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1908. March 16.  
G. M. T. 21<sup>h</sup> 42<sup>m</sup>

HERCULIS 1463.

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7088           |                          |                              |           | 1   | 27 4090           | 3380                     | 0746                         | [-64.75]+ |
| 1   | 53 8238           | 8561                     | 1137                         | 129.87    | 1   | 27 3376           | 2666                     | 1460                         | -126.73+  |
| 2   | 53 0835           |                          |                              |           | 2   | 27 3189           |                          |                              |           |
| 3   | 45 2754           |                          |                              |           | 1   | 11 8287           | 7037                     | 1477                         | -110.63   |
| 2   | 45 1363           | 1345                     | 1042                         | -108.78   | 2   | 11 6827           |                          |                              |           |
| 1   | 27 4961           | 4251                     | 0125                         | [-10.85]  |     |                   |                          |                              |           |

Weighted mean 4 lines..... 117.66  
 $V_d$ ..... -16.96  
 $V_d$ ..... .05  
 Curvature..... 28  
 Radial velocity..... 109.9

\* Red. † Centre. ‡ Violet.

HERCULIS 1483.

1908. April 13.  
G. M. T. 21<sup>h</sup> 35<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 55 0591           | 0413                     | 0839                         | -97.83    | 1/2 | 45 2031           | 1830                     | 0557                         | -58.15    |
| 2   | 54 7597           |                          |                              |           | 2   | 73 0290           |                          |                              |           |
| 3   | 53 8897           | 8728                     | 0970                         | -111.65   | 2   | 66 3185           | 2998                     | 1119                         | +145.09   |
| 2   | 53 1281           |                          |                              |           | 1   | 41 4857           | 4625                     | 1653                         | +165.30   |
| 2   | 45 2936           |                          |                              |           | 2   | 41 3087           |                          |                              |           |

Weighted mean neg. lines..... -102.63  
 $V_d$ ..... +12.31  
 $V_d$ ..... - .09  
 Curvature..... 28  
 Radial velocity..... -90.7

HERCULIS 1494.

1908, April 15.  
G. M. T. 20<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7571           |                          |                              |           | 1   | 27 5470           |                          |                              |           |
| 1   | 54 0087           | 9910                     | 0212                         | 24.40     | 2   | 27 3528           | 4416                     | 0290                         | 25.17     |
| 2   | 53 1325           |                          |                              |           | 1½  | 12 0567           | 8947                     | 0433                         | -32.43    |
| 2   | 45 3117           |                          |                              |           | 2   | 11 6701           |                          |                              |           |
| 1½  | 45 2995           | 2614                     | 0227                         | 23.70     |     |                   |                          |                              |           |

Weighted mean ..... - 26.75  
 $V_a$  ..... - 11.87  
 $V_d$  ..... .04  
 Curvature ..... .28  
 Radial velocity ..... - 38.3

HERCULIS 1511.

1908, April 22.  
G. M. T. 20<sup>h</sup> 33<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7537           |                          |                              |           | 1½  | 27 4398           | 3576                     | 0550                         | 47.74     |
| 1   | 53 9496           | 9343                     | 0355                         | -40.86    | 2   | 27 3292           |                          |                              |           |
| 2   | 53 1311           |                          |                              |           | 1   | 11 9322           | 7951                     | 0557                         | -41.72    |
| 2   | 45 2841           |                          |                              |           | 2   | 11 6453           |                          |                              |           |
| 1½  | 45 2051           | 1947                     | 0440                         | 45.93     |     |                   |                          |                              |           |

Weighted mean ..... - 44.61  
 $V_a$  ..... - 10.16  
 $V_d$  ..... .05  
 Curvature ..... .28  
 Radial velocity ..... - 34.8

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$\epsilon$  HERCULIS 1511.

1908. April 22.  
G. M. T. 20<sup>h</sup> 53<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54.7475           |                          |                              |           | 1             | 27.4466           | 3521                     | 0695                         | 52.51     |
| $\frac{1}{2}$ | 53.9314           | 9240                     | 0498                         | -57.31    | 2             | 27.3416           |                          |                              |           |
| 2             | 53.1213           |                          |                              |           | $\frac{1}{2}$ | 11.9315           | 7915                     | 0600                         | 44.94     |
| 2             | 45.3027           |                          |                              |           | 2             | 11.6479           |                          |                              |           |
| 1             | 15.2245           | 1995                     | 0393                         | 0.02      |               |                   |                          |                              |           |

Weighted mean ..... 48.22  
 $V_a$  ..... 10.16  
 $V_d$  ..... .05  
 Curvature ..... .28

\* Check measurement.

Radial velocity ..... - 38.4

$\epsilon$  HERCULIS 1531.

1908. May 15.  
G. M. T. 19<sup>h</sup> 29<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0237           |                          |                              |           | $\frac{1}{2}$ | 45.1314           | 1565                     | 0822                         | 85.81     |
| $\frac{1}{2}$ | 72.8254           | 8127                     | 0521                         | -75.59    | 2             | 43.5083           |                          |                              |           |
| 1             | 72.4550           |                          |                              |           | $\frac{1}{2}$ | 27.3377           | 3391                     | 0825                         | -71.04    |
| 1             | 45.2488           |                          |                              |           | 2             | 27.2542           |                          |                              |           |

Weighted mean ..... - 77.48  
 $V_a$  ..... + 3.87  
 $V_d$  ..... .11  
 Curvature ..... .28

Radial velocity ..... - 74.0

$\epsilon$  HERCULIS 1531.\*

1908. May 15.  
G. M. T. 19<sup>h</sup> 29<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. S. PLASKETT.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 45.2620           |                          |                              |           | 2             | 15.3652           |                          |                              |           |
| $\frac{1}{2}$ | 45.1435           | 1651                     | 0736                         | -76.84    | 1             | 15.3325           | 3730                     | 1003                         | 77.63     |
| 1             | 27.2702           | 3206                     | 0920                         | 79.86     | $\frac{1}{2}$ | 11.7025           | 7530                     | 0934                         | -73.70    |
| 2             | 27.1935           |                          |                              |           | 2             | 11.4650           |                          |                              |           |

Weighted mean ..... - 77.49  
 $V_a$  ..... + 3.87  
 $V_d$  ..... .11  
 Curvature ..... .28

Radial velocity ..... - 73.9

\* Check measurement.

HERCULIS 1540.

1908, May 18,  
G. M. T. 18<sup>h</sup> 25<sup>m</sup>

Observed by T. H. PARKER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72.9755           |                          |                              |           | $\frac{1}{2}$ | 45.2462           |                          |                              |           |
| $\frac{1}{2}$ | 72.8376           | 8724                     | 0076                         | -11.02    | 2             | 43.5332           |                          |                              |           |
| 1             | 72.4074           |                          |                              |           | 2             | 27.2667           |                          |                              |           |
| 2             | 45.2650           |                          |                              |           | $\frac{1}{2}$ | 27.4414           | 4203                     | 0077                         | +6.68     |

Weighted mean..... +11.47  
 $V_a$ ..... +3.01  
 $V_d$ ..... - .04  
 Curvature..... - .28

Radial velocity..... +14.2

HERCULIS 1540.\*

1908, May 18,  
G. M. T. 18<sup>h</sup> 25<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 57.8390           |                          |                              |           | $\frac{1}{2}$ | 27.4464           | 3946                     | 0180                         | 15.62     |
| $\frac{1}{2}$ | 57.8150           | 8054                     | 0214                         | -25.76    | 2             | 27.2984           |                          |                              |           |
| 2             | 54.7533           |                          |                              |           | 1             | 11.9200           | 8464                     | 0050                         | -3.75     |
| 1             | 53.9750           | 9629                     | 0019                         | -2.18     | 2             | 11.5812           |                          |                              |           |
| $\frac{1}{2}$ | 53.1249           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean..... -4.73  
 $V_a$ ..... +3.01  
 $V_d$ ..... - .04  
 Curvature..... - .28

Radial velocity..... -2.0

\* Check measurement.

HERCULIS 1545.

1908, May 20,  
G. M. T. 14<sup>h</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54.7596           |                          |                              |           | $\frac{1}{2}$ | 27.4008           | 3230                     | 0896                         | 77.77     |
| $\frac{1}{2}$ | 53.9253           | 9080                     | 0618                         | -71.13    | 1             | 27.3245           |                          |                              |           |
| 2             | 53.0461           |                          |                              |           | $\frac{1}{2}$ | 15.4875           | 3780                     | 0953                         | -73.76    |
| 2             | 43.5702           |                          |                              |           | 1             | 15.5081           |                          |                              |           |

Weighted mean..... -76.10  
 $V_a$ ..... +2.47  
 $V_d$ ..... +.07  
 Curvature..... - .28

Radial velocity..... -73.8

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$\epsilon$  HERCULIS 1547.

1908. May 22.  
G. M. T. 18<sup>h</sup> 2<sup>m</sup>

Observed by i W. F. HARPER.  
Measured by j

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54 7307           |                          |                              |           | 2             | 45 2669           |                          |                              |           |
| $\frac{1}{2}$ | 53 9373           | 8979                     | 0219                         | -25.21    | $\frac{1}{2}$ | 45 1984           | 2651                     | 0336                         | -35.08    |
| 2             | 53 1021           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 30 15  
 $V_a$  ..... - 1.93  
 $V_d$  ..... - .04  
 Curvature ..... - .28  
 Radial velocity ..... - 28.5

$\epsilon$  HERCULIS 1567.

1908. June 1.  
G. M. T. 17<sup>h</sup> 3<sup>m</sup>

Observed by T. H. PARKER  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54 7282           |                          |                              |           | 2             | 45 2682           |                          |                              |           |
| $\frac{3}{4}$ | 53 8856           | 8976                     | 0722                         | -83.10    | $\frac{1}{4}$ | 45 1598           | 1652                     | 0735                         | -76.73    |
| 2             | 53 1018           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 81.51  
 $V_a$  ..... - 1.17  
 $V_d$  ..... - .16  
 Curvature ..... - .28  
 Radial velocity ..... - 83.1

$\epsilon$  HERCULIS 1573.

1908. June 3.  
G. M. T. 17<sup>h</sup> 56<sup>m</sup>

Observed by i W. E. HARPER.  
Measured by j

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9922           |                          |                              |           | 2             | 53 1190           |                          |                              |           |
| 1             | 72 8323           | 8513                     | 0135                         | -19.59    | 2             | 45 2871           |                          |                              |           |
| 2             | 72 4216           |                          |                              |           | $\frac{1}{2}$ | 45 2517           | 2382                     | 0005                         | 0.52      |
| 2             | 54 7443           |                          |                              |           | 1             | 27 4595           | 4062                     | 0064                         | -5.55     |
| $\frac{1}{2}$ | 53 9692           | 9645                     | 0053                         | 6.10      | 2             | 27 2999           |                          |                              |           |

Weighted mean ..... - 7.23  
 $V_a$  ..... - 1.74  
 $V_d$  ..... - .06  
 Curvature ..... - .28  
 Radial velocity ..... - 9.3

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$\epsilon$  HERCULIS 1573.

1908, June 3,  
G. M. T. 17<sup>h</sup> 56<sup>m</sup>

Observed by W. E. HARPER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0222           |                          |                              |           | $\frac{1}{3}$ | 45.2750           | 2294                     | .0093                        | 9.71      |
| $\frac{1}{2}$ | 72.8697           | 8570                     | .0078                        | 11.32     | $\frac{1}{2}$ | 27.4850           | 4000                     | .0126                        | -10.94    |
| 2             | 72.4536           |                          |                              |           | 2             | 27.3321           |                          |                              |           |
| 2             | 45.3195           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 10.66  
 $V_a$  ..... - 1.74  
 $V_d$  ..... - .06  
 Curvature ..... - .28

\* Check measurement.

Radial velocity ..... - 12.7

$\epsilon$  HERCULIS 1582.

1908, June 5,  
G. M. T. 18<sup>h</sup> 40<sup>m</sup>

Observed by T. H. PARKER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0057           |                          |                              |           | 2   | 45.2847           |                          |                              |           |
| $\frac{1}{2}$ | 72.8289           | 8328                     | .0320                        | -46.43    | 1   | 45.1877           | 1766                     | .0621                        | 64.83     |
| 1             | 72.4415           |                          |                              |           | 2   | 43.5492           |                          |                              |           |
| 1             | 54.7435           |                          |                              |           | 1   | 27.3405           | 3509                     | .0617                        | -53.55    |
| 2             | 53.9113           | 9085                     | .0613                        | 70.55     | 2   | 27.2362           |                          |                              |           |
| 1             | 53.1160           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 62.82  
 $V_a$  ..... - 2.34  
 $V_d$  ..... - .13  
 Curvature ..... - .28

Radial velocity ..... - 65.6

$\epsilon$  HERCULIS 1603.

1908, June 12,  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

Observed by T. H. PARKER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0039           |                          |                              |           | $\frac{1}{3}$ | 27.3556           | 3660                     | .0466                        | 40.44     |
| $\frac{1}{2}$ | 72.8098           | 8174                     | .0474                        | 68.77     | 2             | 27.2362           |                          |                              |           |
| 2             | 72.4334           |                          |                              |           | 2             | 54.7252           |                          |                              |           |
| 2             | 45.2849           |                          |                              |           | 1             | 53.9368           | 9481                     | .0217                        | -24.97    |
| 1             | 45.1905           | 1792                     | .0595                        | 62.11     | 1             | 53.0175           |                          |                              |           |
| 3             | 43.5509           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 47.23  
 $V_a$  ..... - 4.39  
 $V_d$  ..... - .14  
 Curvature ..... - .28

Radial velocity ..... - 52.0



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• HERCULIS 1603.\*

1908, June 12.  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7330           |                          |                              |           | 1   | 45.1900           | 1834                     | 0553                         | + 57.73   |
| 1½  | 53.9468           | 9515                     | 0183                         | - 21.06   | 2   | 45.2802           |                          |                              |           |
| 1   | 53.1052           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 35.73  
 $V_a$  ..... - 4.39  
 $V_d$  ..... - .14  
 Curvature ..... - .28

Radial velocity ..... - 40.5

\* Check measurement.

• HERCULIS 1625.

1908, June 22.  
G. M. T. 17<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7181           |                          |                              |           | ½   | 27.4445           | 4251                     | 0125                         | + 10.85   |
| 2   | 53.9437           | 9684                     | 0014                         | - 1.91    | 2   | 27.2660           |                          |                              |           |
| 2   | 53.0867           |                          |                              |           | ½   | 11.8797           | 8502                     | 6012                         | - 0.90    |
| 2   | 45.2605           |                          |                              |           | 2   | 11.5367           |                          |                              |           |
| 1   | 45.2005           | 2137                     | 0250                         | - 26.10   |     |                   |                          |                              |           |

Weighted mean ..... - 6.24  
 $V_a$  ..... - 7.15  
 $V_d$  ..... - .11  
 Curvature ..... - .28

Radial velocity ..... - 13.8

• HERCULIS 1630.

1908, June 24.  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0647           |                          |                              |           | 2   | 45.3237           |                          |                              |           |
| 1   | 72.9033           | 8481                     | 0167                         | - 24.23   | 2   | 45.2575           | 2074                     | 0313                         | 32.68     |
| 2   | 72.5011           |                          |                              |           | 1½  | 27.4458           | 3860                     | 0266                         | 23.09     |
| 2   | 54.7925           |                          |                              |           | 2   | 27.3065           |                          |                              |           |
| 1½  | 53.9978           | 9484                     | 0214                         | 24.63     | 2   | 11.8987           | 8362                     | 0152                         | - 11.38   |
| 2   | 53.1602           |                          |                              |           | 2   | 11.5698           |                          |                              |           |

Weighted mean ..... - 23.00  
 $V_a$  ..... - 7.68  
 $V_d$  ..... - .04  
 Curvature ..... - .28

Radial velocity ..... - 31.0

ε HERCULIS 1649.

1908. June 26.  
G. M. T. 16<sup>h</sup> 46<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7353           |                          |                              |           | 2   | 53 1042           |                          |                              |           |
| 1   | 53 9739           | 9826                     | 0128                         | -14 73    |   |                   |                          |                              |           |
|     |                   |                          |                              |           | $V_s$ ..... + 14 73<br>$V_a$ ..... - 8 21<br>$V_d$ ..... - 09<br>Curvature ..... - 28 |                   |                          |                              |           |
|     |                   |                          |                              |           | Radial velocity ..... + 6 1   |                   |                          |                              |           |

ε HERCULIS 1648.

1908. June 27.  
G. M. T. 17<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 6613           |                          |                              |           | 2   | 27 3914           | 4389                     | 0266                         | 22 06     |
| 1½  | 53 9578           | 0373                     | 0675                         | 77 80     | 3   | 27 2075           |                          |                              |           |
| 2   | 53 0325           |                          |                              |           | 1   | 11 8777           | 9092                     | 0578                         | +43 29    |
| 2   | 45 2056           |                          |                              |           | 3   | 11 4693           |                          |                              |           |
| 1½  | 45 1725           | 2405                     | 0018                         | 1 88      |   |                   |                          |                              |           |
|     |                   |                          |                              |           | Weighted mean ..... + 34 49<br>$V_s$ ..... - 8 47<br>$V_d$ ..... - 11<br>Curvature ..... - 28 |                   |                          |                              |           |
|     |                   |                          |                              |           | Radial velocity ..... + 25 6  |                   |                          |                              |           |

ε HERCULIS 1648.\*

1908. June 27.  
G. M. T. 17<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0323           |                          |                              |           | 2   | 45 3181           |                          |                              |           |
| 1   | 72 9046           | 8746                     | 0698                         | +14 22    | 1½  | 45 2971           | 2531                     | 0144                         | 15 05     |
| 2   | 72 4869           |                          |                              |           | 1½  | 27 5276           | 4586                     | 0410                         | 35 59     |
| 2   | 54 7887           |                          |                              |           | 3   | 27 3309           |                          |                              |           |
| 1½  | 54 0660           | 0260                     | 0562                         | 64 69     | 1½  | 12 0159           | 9229                     | 0715                         | +53 63    |
| 2   | 53 1513           |                          |                              |           | 3   | 11 5935           |                          |                              |           |
|     |                   |                          |                              |           | Weighted mean ..... + 42 15<br>$V_s$ ..... - 8 47<br>$V_d$ ..... - 11<br>Curvature ..... - 29 |                   |                          |                              |           |
|     |                   |                          |                              |           | Radial velocity ..... + 29 4  |                   |                          |                              |           |

\* Check measurement.

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ε HERCULIS 1648.\*

1908. June 27.  
G. M. T. 17<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-------|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2     | 54 7470           | .....                    | .....                        | .....     | 1/2   | 27 4466           | 4322                     | 0196                         | 17 01     |
| 1     | 54 0110           | 0063                     | 0365                         | +42 01    | 2     | 27 2610           | .....                    | .....                        | .....     |
| 2     | 53 1164           | .....                    | .....                        | .....     | 1     | 11 9287           | 0637                     | 0523                         | +39 17    |
| 2     | 45 2902           | .....                    | .....                        | .....     | 2     | 11 5822           | .....                    | .....                        | .....     |
| 1 1/2 | 45 2737           | 2571                     | 0184                         | 19 21     | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... +29 62  
 $V_a$  ..... - 8 47  
 $V_d$  ..... - 11  
 Curvature ..... - 28

Radial velocity ..... + 20 8

\* Check measurement.

ε HERCULIS 1653.

1908. July 1.  
G. M. T. 16<sup>h</sup> 15<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7746           | .....                    | .....                        | .....     | 1     | 27 5156           | 4756                     | 0630                         | 54 68     |
| 2   | 54 0547           | 0247                     | 0549                         | +63 19    | 3     | 27 2893           | .....                    | .....                        | .....     |
| 2   | 53 1395           | .....                    | .....                        | .....     | 1 1/2 | 11 9291           | 8871                     | 0857                         | +26 76    |
| 2   | 45 3045           | .....                    | .....                        | .....     | 3     | 11 5478           | .....                    | .....                        | .....     |
| 1   | 45 2795           | 2490                     | 0103                         | 10 75     | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... +42 17  
 $V_a$  ..... - 9 48  
 $V_d$  ..... - 11  
 Curvature ..... - 28

Radial velocity ..... +33 3

ε HERCULIS 1653.\*

1908. July 1.  
G. M. T. 16<sup>h</sup> 15<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7392           | .....                    | .....                        | .....     | 1/2   | 27 4403           | 4400                     | 0274                         | 23 78     |
| 1   | 53 9887           | 9943                     | 0245                         | +28 20    | 2     | 27 2470           | .....                    | .....                        | .....     |
| 1   | 53 1035           | .....                    | .....                        | .....     | 1     | 11 8804           | 8856                     | 0312                         | +25 61    |
| 2   | 45 2625           | .....                    | .....                        | .....     | 2     | 11 5020           | .....                    | .....                        | .....     |
| 1/2 | 45 2276           | 2387                     | 0000                         | 00        | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... +21 90  
 $V_a$  ..... - 9 48  
 $V_d$  ..... - 06  
 Curvature ..... - 28

Radial velocity ..... +12 1

\* Check measurement.

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1908, July 1  
G. M. T. 16<sup>m</sup> 15<sup>s</sup>

HERCULIS 1653.\*

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| $\frac{2}{1}$   | 54 8447           |                          |                              |           | $\frac{1}{1}$ | 45 3489           | 2587                     | 0150                         | 15.66     |
| $\frac{1}{2}$   | 53 6962           | 9977                     | 9279                         | 32.11     | 1             | 44 9904           | 8880                     | 0366                         | -27.41    |
| $\frac{2}{2}$   | 53 2062           |                          |                              |           | 2             | 44 6096           |                          |                              |           |
| $\frac{2}{2}$   | 45 3688           |                          |                              |           |               |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |               |                   |                          |                              | -26.94    |
| $V_a$           |                   |                          |                              |           |               |                   |                          |                              | 9.48      |
| $V_d$           |                   |                          |                              |           |               |                   |                          |                              | 11        |
| Curvature       |                   |                          |                              |           |               |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |               |                   |                          |                              | -17.1     |

\* Check measurement.

1908, July 3.  
G. M. T. 19<sup>m</sup> 40<sup>m</sup>

HERCULIS 1661.

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| $\frac{2}{2}$   | 54 7681           |                          |                              |           | 2   | 45 2998           |                          |                              |           |
| $\frac{2}{2}$   | 53 9294           | 9904                     | 0694                         | 79.88     | 1   | 45 2348           | 2268                     | 0119                         | -13.61    |
| $\frac{2}{2}$   | 53 1436           |                          |                              |           |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | -49.53    |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | 9.97      |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | 26        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | -69.0     |

1908, July 3.  
G. M. T. 19<sup>m</sup> 40<sup>m</sup>

HERCULIS 1661.\*

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 54 7214           |                          |                              |           | 2             | 45 2530           |                          |                              |           |
| 2               | 53 8761           | 8968                     | 9739                         | -84.02    | $\frac{3}{2}$ | 45 1670           | 1877                     | 0510                         | -53.24    |
| 2               | 53 0911           |                          |                              |           |               |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |               |                   |                          |                              | -75.62    |
| $V_a$           |                   |                          |                              |           |               |                   |                          |                              | 9.97      |
| $V_d$           |                   |                          |                              |           |               |                   |                          |                              | 26        |
| Curvature       |                   |                          |                              |           |               |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |               |                   |                          |                              | -86.1     |

\* Check measurement.

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HERCULIS 1666.

1908, July 6.  
G. M. T. 17<sup>h</sup> 35<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7101           |                          |                              |           | 1½  | 27 3494           | 3334                     | 0192                         | 16 66     |
| 1   | 53 8809           | 9180                     | 0518                         | -59 62    | 2   | 27 1962           |                          |                              |           |
| 2   | 53 0710           |                          |                              |           | 1   | 11 7754           | 8284                     | 0230                         | -17 23    |
| 2   | 45 2333           |                          |                              |           | 2   | 11 4534           |                          |                              |           |
| 1½  | 45 1985           | 2375                     | 0012                         | 1 25      |     |                   |                          |                              |           |

Weighted mean . . . . . -20 71  
 $V_a$  . . . . . -10 70  
 $V_d$  . . . . . - 06  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -31 7

HERCULIS 1666.\*

1908, July 6.  
G. M. T. 17<sup>h</sup> 35<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 8433           |                          |                              |           | 1½  | 45 2230           | 2223                     | 0164                         | -17 20    |
| ½   | 57 8432           | 8293                     | 0025                         | + 3 01    | ½   | 27 3862           | 3874                     | 0252                         | -21 87    |
| 2   | 54 7567           |                          |                              |           | 2   | 27 2454           |                          |                              |           |
| 2   | 53 9847           | 9752                     | 0054                         | + 6 21    | ½   | 11 8301           | 8383                     | 0131                         | - 9 81    |
| 1   | 53 1164           |                          |                              |           | 2   | 11 5190           |                          |                              |           |
| 2   | 45 2745           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean . . . . . - 5 54  
 $V_a$  . . . . . -10 70  
 $V_d$  . . . . . - 06  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -16 6

\* Check measurement.

ε HERCULIS 1675.

1908. July 8.  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0235           |                          |                              |           | 3   | 45 2741           |                          |                              |           |
| 1   | 72 8670           | 8584                     | 0114                         | -16 54    | 1½  | 45 2271           | 2267                     | 0120                         | -12 53    |
| 2   | 72 4584           |                          |                              |           | 1   | 27 4307           | 4076                     | 0050                         | -4 34     |
| 2   | 54 7415           |                          |                              |           | 2   | 27 2697           |                          |                              |           |
| 1½  | 53 9786           | 9803                     | 0105                         | -12 08    | 1   | 11 8571           | 8288                     | 0236                         | -16 93    |
| 1½  | 53 1030           |                          |                              |           | 2   | 11 5355           |                          |                              |           |

Weighted mean. . . . . - 6 41  
 $V_a$  . . . . . - 11 15  
 $V_d$  . . . . . - 07  
 Curvature. . . . . - 28  
 Radial velocity . . . . . - 17 9

ε HERCULIS 1675.\*

1908. July 8.  
G. M. T. 15<sup>h</sup> 47<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| ½   | 57 7785           | 8817                     | 0049                         | + 6 02    | 1½  | 45 1881           | 2350                     | 0037                         | - 3 86    |
| 2   | 57 7702           |                          |                              |           | 2   | 39 8478           |                          |                              |           |
| 2   | 54 6950           |                          |                              |           | 1   | 27 3860           | 4072                     | 0054                         | - 4 69    |
| 2   | 53 9312           | 9798                     | 0100                         | -11 51    | 2   | 27 2254           |                          |                              |           |
| 2   | 53 0617           |                          |                              |           | 1   | 11 8146           | 8393                     | 0211                         | -15 80    |
| 2   | 45 2267           |                          |                              |           | 2   | 11 4915           |                          |                              |           |

Weighted mean. . . . . - 0 04  
 $V_a$  . . . . . - 11 15  
 $V_d$  . . . . . - 07  
 Curvature. . . . . - 28  
 Radial velocity. . . . . - 11 5

\* Check measurement.

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$\epsilon$  HERCULIS 1676.

1908, July 8,  
G. M. T. 16<sup>h</sup> 32<sup>m</sup>

Observed by J. P. CANNON.  
Measured by f

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 54.8885           |                          |                              |           | 1               | 27.5711           | 4631                     | 0095                         | 8.25      |
| 1 $\frac{1}{2}$ | 54.0948           | 9498                     | 0200                         | -23.02    | 2               | 27.4152           |                          |                              |           |
| 2               | 53.2536           |                          |                              |           | 1               | 12.0378           | 8489                     | 0025                         | -1.87     |
| 2               | 45.4243           |                          |                              |           | 2 $\frac{1}{2}$ | 11.6959           |                          |                              |           |
| 1               | 45.3866           | 2356                     | 0031                         | 3.24      |                 |                   |                          |                              |           |

Weighted mean ..... - 10.64  
 $V_a$  ..... - 11.15  
 $V_d$  ..... - .14  
 Curvature ..... - .28  
 Radial velocity ..... - 22.2

$\epsilon$  HERCULIS 1682.

1908, July 9,  
G. M. T. 17<sup>h</sup> 12<sup>m</sup>

Observed by W. E. HARPER.  
Measured by f

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 73.0156           |                          |                              |           | 1 $\frac{1}{2}$ | 45.2675           | 2565                     | 0178                         | +18.58    |
| 1 $\frac{1}{2}$ | 72.8768           | 8714                     | 0066                         | +9.57     | 2               | 41.2977           |                          |                              |           |
| 2               | 72.4490           |                          |                              |           | 1 $\frac{1}{2}$ | 27.4402           | 4102                     | 0024                         | -2.08     |
| 2               | 54.7490           |                          |                              |           | 2               | 27.2766           |                          |                              |           |
| 3               | 54.0263           | 0207                     | 0009                         | +70.09    | 1 $\frac{1}{2}$ | 11.9452           | 9044                     | 0530                         | +39.70    |
| 2               | 53.1160           |                          |                              |           | 2               | 11.5482           |                          |                              |           |
| 2               | 45.2846           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean ..... + 42.97  
 $V_a$  ..... - 11.36  
 $V_d$  ..... - .15  
 Curvature ..... - .28  
 Radial velocity ..... + 31.2

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HERCULIS 1685.

1908. July 10.  
G. M. T. 14<sup>h</sup> 37<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 54 7810           |                          |                              |           | 1½  | 27 4458           | 3880                     | 0246                         | 21 35     |
| 2               | 53 9982           | 9602                     | 0096                         | - 11 49   | 2   | 27 3042           |                          |                              |           |
| 2               | 53 1509           |                          |                              |           | 1½  | 11 8880           | 8260                     | 0254                         | - 19 02   |
| 2               | 45 3197           |                          |                              |           | 2   | 11 5696           |                          |                              |           |
| 1               | 45 2720           | 2260                     | 0127                         | 13 26     |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | - 16 13   |
| V <sub>a</sub>  |                   |                          |                              |           |     |                   |                          |                              | 11 58     |
| V <sub>d</sub>  |                   |                          |                              |           |     |                   |                          |                              | 00        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | 27 9      |

HERCULIS 1686.

1908. July 10.  
G. M. T. 15<sup>h</sup> 34<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 54 7365           |                          |                              |           | ½   | 27 4528           |                          |                              |           |
| 1½              | 53 9496           | 9535                     | 0163                         | - 18 76   | 2   | 27 2597           |                          |                              |           |
| 2               | 53 1102           |                          |                              |           | 1½  | 11 8304           | 8099                     | 0415                         | - 31 07   |
| 2               | 45 2762           |                          |                              |           | 2   | 11 5280           |                          |                              |           |
| 1               | 45 2158           | 2146                     | 0230                         | 24 01     |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | - 24 56   |
| V <sub>a</sub>  |                   |                          |                              |           |     |                   |                          |                              | - 11 58   |
| V <sub>d</sub>  |                   |                          |                              |           |     |                   |                          |                              | 06        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | 36 4      |

HERCULIS 1693.

1908. July 11.  
G. M. T. 16<sup>h</sup> 58<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1               | 73 0169           |                          |                              |           | 1½  | 45 1437           | 1197                     | 1198                         | 125 07    |
| 1               | 72 7961           | 7998                     | 0650                         | - 94 52   | 1   | 27 2885           | 2685                     | 1440                         | 124 99    |
| 1               | 54 7200           |                          |                              |           | 2   | 27 2267           |                          |                              |           |
| 2               | 53 8695           | 8415                     | 1283                         | 147 67    | 1   | 11 7051           | 6841                     | 1673                         | - 115 31  |
| 2               | 53 0811           |                          |                              |           | 2   | 11 4860           |                          |                              |           |
| 2               | 45 2396           |                          |                              |           |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | - 125 81  |
| V <sub>a</sub>  |                   |                          |                              |           |     |                   |                          |                              | - 11 83   |
| V <sub>d</sub>  |                   |                          |                              |           |     |                   |                          |                              | 14        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | 138 1     |



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$\epsilon$  HERCULIS 1693.\*

1908, July 11,  
G. M. T. 16<sup>h</sup> 58<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 54 6857           |                          |                              |           | 1 $\frac{1}{2}$ | 27 2729           | 3166                     | 6960                         | 83 33     |
| 2   | 53 8389           | 8908                     | 0790                         | 90 93     | 2               | 27 2031           |                          |                              |           |
| 1   | 53 0466           |                          |                              |           | 1               | 11 6737           | 7328                     | 1186                         | 88 83     |
| 2   | 45 2135           |                          |                              |           | 2               | 11 4481           |                          |                              |           |
| 1   | 45 1326           | 1927                     | 0460                         | 48 02     |                 |                   |                          |                              |           |

Weighted mean ..... 80 67  
 $V_a$  ..... 11 83  
 $V_d$  ..... 14  
 Curvature ..... 28

\* Check measurement.

Radial velocity ..... 92 9

$\epsilon$  HERCULIS 1699.

1908, July 13,  
G. M. T. 16<sup>h</sup> 19<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 72 9161           |                          |                              |           | 1 $\frac{1}{2}$ | 27 3386           | 3706                     | 0513                         | +44 53    |
| 2   | 72 7681           | 8611                     | 0037                         | - 5 37    | 2               | 27 2138           |                          |                              |           |
| 2   | 72 3520           |                          |                              |           | 1 $\frac{1}{2}$ | 11 8957           | 9057                     | 0543                         | +40 67    |
| 2   | 45 2128           |                          |                              |           | 2               | 11 4945           |                          |                              |           |
| 1   | 45 1745           | 2353                     | 0634                         | - 3 55    |                 |                   |                          |                              |           |

Weighted mean ..... +22 00  
 $V_a$  ..... -12 28  
 $V_d$  ..... - 14  
 Curvature ..... 28

Radial velocity ..... - 9 3

$\epsilon$  HERCULIS 1699.\*

1908, July 13  
G. M. T. 16<sup>h</sup> 19<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 72 8786           |                          |                              |           | 1               | 52 9980           |                          |                              |           |
| 2   | 72 7355           | 8648                     | 0000                         | 0 00      | 2               | 45 1721           |                          |                              |           |
| 2   | 72 3211           |                          |                              |           | 1               | 45 1655           | 2670                     | 0283                         | +29 54    |
| 2   | 54 6267           |                          |                              |           | 1 $\frac{1}{2}$ | 11 8675           | 9317                     | 0803                         | +60 14    |
| 1   | 53 8710           | 9856                     | 0158                         | +18 18    | 2               | 11 4430           |                          |                              |           |

Weighted mean ..... -34 48  
 $V_a$  ..... -12 28  
 $V_d$  ..... - 14  
 Curvature ..... 28

\* Check measurement.

Radial velocity ..... -21 8

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## ε HERCULIS 1707.

1908. July 14.  
G. M. T. 17<sup>h</sup> 42<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72 9823           |                          |                              |           | 2   | 45 2751           |                          |                              |           |
| 1             | 72 8174           | 8454                     | 0194                         | -28 15    | 2   | 45 2115           | 2100                     | 0287                         | 29 96     |
| 1             | 72 4157           |                          |                              |           | 2   | 27 4009           | 3709                     | 0417                         | 36 20     |
| 2             | 54 7221           |                          |                              |           | 2   | 27 2759           |                          |                              |           |
| $\frac{1}{2}$ | 53 9413           | 9573                     | 0125                         | 14 39     | 2   | 11 8686           | 8106                     | 0408                         | 39 56     |
| 2             | 53 0976           |                          |                              |           | 2   | 11 5667           |                          |                              |           |

Weighted mean . . . . . -30 50  
 $V_a$  . . . . . -12 58  
 $V_d$  . . . . . - 19  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -43 6

## ε HERCULIS 1712.

1908. July 15.  
G. M. T. 17<sup>h</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 54 7925           |                          |                              |           | 1   | 27 4363           | 3593                     | 0533                         | 46 26     |
| $\frac{1}{2}$   | 53 9323           | 8803                     | 0795                         | -91 50    | 2   | 27 3102           |                          |                              |           |
| 2               | 53 1660           |                          |                              |           | 1   | 11 7814           | 7214                     | 1300                         | -97 37    |
| 2               | 45 3233           |                          |                              |           | 2   | 11 5975           |                          |                              |           |
| 1 $\frac{1}{2}$ | 45 2363           | 1863                     | 0524                         | 54 71     |     |                   |                          |                              |           |

Weighted mean . . . . . -67 88  
 $V_a$  . . . . . -12 81  
 $V_d$  . . . . . - 14  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -81 1

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1908, July 15,  
G. M. T. 17<sup>h</sup> 45<sup>m</sup>

ε HERCULIS 4713.

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72.9943           |                          |                              |           | 2             | 45.2700           |                          |                              |           |
| $\frac{1}{2}$ | 72.8335           | 8495                     | .0153                        | -22.20    | $\frac{1}{2}$ | 45.1889           | 1924                     | .0463                        | 48.34     |
| 1             | 72.4275           |                          |                              |           | $\frac{1}{2}$ | 27.3745           | 3583                     | .0543                        | 47.13     |
| 2             | 54.7248           |                          |                              |           | 2             | 27.2630           |                          |                              |           |
| 1             | 53.8913           | 9083                     | .0615                        | 70.79     | $\frac{1}{2}$ | 11.8010           | 7715                     | .0799                        | -59.92    |
| 2             | 53.1022           |                          |                              |           | 2             | 11.5368           |                          |                              |           |

Weighted mean ..... - 52.49  
 $V_a$  ..... - 12.80  
 $V_d$  ..... - 19  
 Curvature ..... - 28  
 Radial velocity ..... - 65.8

ε HERCULIS 1719.

1908, July 16,  
G. M. T. 17<sup>h</sup> 25<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54.7686           |                          |                              |           | 1   | 27.4669           | 4142                     | .0077                        | - 6.68    |
| 2             | 53.9945           | 9675                     | .0023                        | - 2.65    | 2   | 27.2995           |                          |                              |           |
| 2             | 53.1399           |                          |                              |           | 2   | 11.9217           | 8562                     | .0048                        | + 3.59    |
| 2             | 45.3019           |                          |                              |           | 2   | 11.5731           |                          |                              |           |
| $\frac{1}{2}$ | 45.2698           | 2368                     | .0019                        | - 1.98    |     |                   |                          |                              |           |

Weighted mean ..... - 0.27  
 $V_a$  ..... - 13.03  
 $V_d$  ..... - 19  
 Curvature ..... - 28  
 Radial velocity ..... - 13.8

ε HERCULIS 1720.

1908, July 22  
G. M. T. 17<sup>h</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 57 8345           |                          |                              |           | 1   | 45 2245           | 2114                     | 0073                         | -18.06    |
| 1   | 57 8370           | 8333                     | 0065                         | 7.83      | 1½  | 24 1614           |                          | 0076                         | -6.46     |
| 1   | 54 7333           |                          |                              |           | 2   | 24 1536           |                          |                              |           |
| 1½  | 53 9636           | 9510                     | 0188                         | 21.64     | 1   | 11 8589           | 8290                     | 0224                         | -22.57    |
| 1   | 53 1255           |                          |                              |           | 2   | 11 5373           |                          |                              |           |
| 2   | 45 2867           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 9.26  
 $V_a$  ..... - 14.00  
 $V_d$  ..... - 19  
 Curvature ..... - .28  
 Radial velocity ..... - 23.7

ε HERCULIS 1723

1908, July 24,  
G. M. T. 14<sup>h</sup>

Observed by W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9270           |                          |                              |           | 2   | 53 0155           |                          |                              |           |
| 1½  | 72 7558           | 8416                     | 0232                         | 33.66     | 2   | 45 1800           |                          |                              |           |
| 1   | 72 3561           |                          |                              |           | 1½  | 45 1312           | 2248                     | 0139                         | -14.51    |
| 2   | 59 7270           |                          |                              |           | 2   | 37 8697           |                          |                              |           |
| 1   | 58 9559           | 0377                     | 0030                         | 3.66      | 1½  | 37 6784           | 7674                     | 0127                         | +12.24    |
| 1   | 57 7351           | 8188                     | 0080                         | 9.63      | 1   | 27 3058           | 3850                     | 0276                         | -23.96    |
| 2   | 57 5079           |                          |                              |           | 2   | 27 1684           |                          |                              |           |
| 2   | 54 6556           |                          |                              |           | 1   | 11 7612           | 8374                     | 0140                         | -10.49    |
| 1½  | 53 8752           | 9665                     | 0033                         | 3.80      | 2   | 11 4310           |                          |                              |           |

Weighted mean ..... - 8.20  
 $V_a$  ..... - 14.35  
 $V_d$  ..... - .00  
 Curvature ..... - .28  
 Radial velocity ..... - 23.8

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1908, July 25,  
G. M. T. 17<sup>h</sup> 20<sup>m</sup>

$\epsilon$  HERCULIS 1728.

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.8772           | .....                    | .....                        | .....     | 1½  | 45.3992           | 2740                     | 0353                         | +36.85    |
| 2   | 54.1331           | 0021                     | 0323                         | +37.18    | 1   | 24.5975           | 4648                     | 0522                         | +45.31    |
| 2   | 53.2387           | .....                    | .....                        | .....     | 2   | 24.3793           | .....                    | .....                        | .....     |
| 2   | 45.3988           | .....                    | .....                        | .....     |     |                   |                          |                              |           |

Weighted mean..... + 38.89  
 $V_a$ ..... 14.53  
 $V_d$ ..... .22  
 Curvature..... .28  
 Radial velocity..... + 23.9

1908, July 26,  
G. M. T. 16<sup>h</sup> 58<sup>m</sup>

$\epsilon$  HERCULIS 1729

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0485           | .....                    | .....                        | .....     | 2   | 53.1465           | .....                    | .....                        | .....     |
| 1   | 72.8867           | 8482                     | 0166                         | -24.08    | 2   | 45.3092           | .....                    | .....                        | .....     |
| 2   | 72.4827           | .....                    | .....                        | .....     | 1½  | 45.2855           | 2500                     | 0113                         | +11.80    |
| 1   | 57.8605           | 8279                     | 0011                         | + 1.32    | 1   | 27.4567           | 4100                     | 0026                         | - 2.26    |
| 2   | 57.8620           | .....                    | .....                        | .....     | 2   | 27.2950           | .....                    | .....                        | .....     |
| 2   | 54.7767           | .....                    | .....                        | .....     | 1½  | 11.8964           | 8496                     | 0018                         | - 1.35    |
| 1   | 53.9981           | 9635                     | 0063                         | - 7.25    | 2   | 11.5540           | .....                    | .....                        | .....     |

Weighted mean..... - 2.37  
 $V_a$ ..... -14.71  
 $V_d$ ..... .29  
 Curvature..... .28  
 Radial velocity..... - 17.6

$\epsilon$  HERCULIS 1734.

1908, July 28  
G. M. T. 17<sup>h</sup> 12<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings | Corrected Star Settings | Displacement in Revolutions | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions | Velocity. |
|-----|------------------|-------------------------|-----------------------------|-----------|---------------|------------------|-------------------------|-----------------------------|-----------|
| 2   | 72 4230          |                         |                             |           | 1             | 45 1967          | 2434                    | 0047                        | + 4 91    |
| 2   | 59 7721          |                         |                             |           | $\frac{1}{2}$ | 27 3527          | 3951                    | 0175                        | -15 19    |
| 2   | 54 7033          |                         |                             |           | 2             | 27 2643          |                         |                             |           |
| 1   | 53 9145          | 9547                    | 0151                        | -17 38    | 1             | 11 7436          | 8210                    | 0304                        | -22 77    |
| 2   | 58 0702          |                         |                             |           | 2             | 11 4292          |                         |                             |           |
| 2   | 45 2269          |                         |                             |           |               |                  |                         |                             |           |

Weighted mean..... -12 24  
 $V_a$ ..... -15 07  
 $V_d$ ..... - 22  
 Curvature..... - 28  
 Radial velocity..... - 27 8

$\epsilon$  HERCULIS 1737.

1908, July 29,  
G. M. T. 14<sup>h</sup> 22<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings | Corrected Star Settings | Displacement in Revolutions | Velocity. | Wt.            | Mean of Settings | Corrected Star Settings | Displacement in Revolutions | Velocity. |
|-----|------------------|-------------------------|-----------------------------|-----------|----------------|------------------|-------------------------|-----------------------------|-----------|
| 2   | 72 9830          |                         |                             |           | 1              | 29 8960          | 9563                    | 0333                        | +32 10    |
| 1   | 72 8682          | 8968                    | 0320                        | +46 45    | 2              | 29 8627          |                         |                             |           |
| 1   | 72 4145          |                         |                             |           | $\frac{1}{2}$  | 27 3845          | 4478                    | 0352                        | +30 55    |
| 2   | 54 6912          |                         |                             |           | 2              | 27 1833          |                         |                             |           |
| 1   | 53 9795          | 0321                    | 0623                        | +71 71    | $1\frac{1}{2}$ | 11 8437          | 9232                    | 0718                        | +53 78    |
| 2   | 54 0574          |                         |                             |           | 1              | 11 6321          |                         |                             |           |
| 2   | 45 2190          |                         |                             |           | 2              | 11 4277          |                         |                             |           |
| 1   | 45 2345          | 2891                    | 0504                        | +52 61    |                |                  |                         |                             |           |

Weighted mean..... +49 80  
 $V_a$ ..... -15 17  
 $V_d$ ..... - 06  
 Curvature..... - 28  
 Radial velocity..... +34 3

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ε HERCULIS 1738.

1908. July 29.  
G. M. T. 15<sup>h</sup> 08<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7011           |                          |                              |           | 1   | 45 2290           | 2753                     | 0366                         | +38.21    |
| 1   | 53 9824           | 0240                     | 0542                         | +62.38    | 2   | 29 8783           |                          |                              |           |
| 2   | 53 0696           |                          |                              |           | 1   | 11 8603           | 9186                     | 0672                         | +50.35    |
| 2   | 45 2273           |                          |                              |           | 2   | 11 4489           |                          |                              |           |

Weighted mean ..... + 50.31  
 $V_a$  ..... - 15.17  
 $V_d$  ..... - .11  
 Curvature ..... - .28  
 Radial velocity ..... + 34.7

ε HERCULIS 1743.

1908. July 29.  
G. M. T. 18<sup>h</sup> 05<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0345           |                          |                              |           | 2   | 54 0317           | 0317                     | 0619                         | -71.25    |
| $\frac{1}{2}$ | 72 8884           | 8670                     | 0022                         | + 3.19    | 2   | 53 1037           |                          |                              |           |
| 2             | 72 4567           |                          |                              |           | 2   | 45 2694           |                          |                              |           |
| 2             | 54 7492           |                          |                              |           | 1   | 45 2692           | 2734                     | 0347                         | +36.23    |
| 3             | 54 0298           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... + 55.91  
 $V_a$  ..... - 15.17  
 $V_d$  ..... - .25  
 Curvature ..... - .28  
 Radial velocity ..... + 40.2

ε HERCULIS 1746.

1908. July 30.  
G. M. T. 17<sup>h</sup> 06<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7460           |                          |                              |           | 2             | 45 2629           |                          |                              |           |
| 2   | 53 9640           | 9628                     | 0070                         | - 8.06    | $\frac{1}{2}$ | 45 2283           | 2390                     | 0003                         | + 0.31    |
| 2   | 53 1102           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 6.47  
 $V_a$  ..... - 15.27  
 $V_d$  ..... - .24  
 Curvature ..... - .28  
 Radial velocity ..... - 22.3

ε HERCULIS 1751.

1908. July 31.  
G. M. T. 17<sup>h</sup> 49<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.                        |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|----------------------------------|
| 1             | 57 8225           |                          |                              |           | 2             | 53 1145           |                          |                              |                                  |
| $\frac{1}{2}$ | 57 7790           | 7859                     | 0410                         | - 49 36   | 2             | 45 2711           |                          |                              |                                  |
| 2             | 54 7461           |                          |                              |           | $\frac{1}{2}$ | 45 1693           | 1717                     | 0670                         | - 69 95                          |
| $\frac{1}{2}$ | 53 9111           | 9078                     | 0620                         | 71 36     |               |                   |                          |                              |                                  |
|               |                   |                          |                              |           |               |                   |                          |                              | Weighted mean . . . . . - 66 38  |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_a$ . . . . . - 15 65          |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_d$ . . . . . - 15             |
|               |                   |                          |                              |           |               |                   |                          |                              | Curvature . . . . . '28          |
|               |                   |                          |                              |           |               |                   |                          |                              | Radial velocity . . . . . - 82 5 |

ε HERCULIS 1757.

1908. July 31.  
G. M. T. 19<sup>h</sup> 05<sup>m</sup>

Observed by W. E. HARPER.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.                        |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|----------------------------------|
| 2             | 73 0630           |                          |                              |           | 2             | 53 1403           |                          |                              |                                  |
| 1             | 72 8552           | 8635                     | 0613                         | - 88 95   | 2             | 45 2950           |                          |                              |                                  |
| 2             | 72 4921           |                          |                              |           | 2             | 45 1340           | 1726                     | 0661                         | - 69 00                          |
| 2             | 54 7682           |                          |                              |           | $\frac{1}{2}$ | 27 3792           | 3631                     | 0495                         | - 42 97                          |
| $\frac{1}{2}$ | 53 9147           | 8874                     | 0824                         | 94 84     | 1             | 27 2627           |                          |                              |                                  |
|               |                   |                          |                              |           |               |                   |                          |                              | Weighted mean . . . . . - 78 14  |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_a$ . . . . . - 15 65          |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_d$ . . . . . - 28             |
|               |                   |                          |                              |           |               |                   |                          |                              | Curvature . . . . . '28          |
|               |                   |                          |                              |           |               |                   |                          |                              | Radial velocity . . . . . - 94 3 |

ε HERCULIS 1760.

1908. Aug. 1.  
G. M. T. 16<sup>h</sup> 49<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.                        |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|----------------------------------|
| 2             | 54 7274           |                          |                              |           | 2   | 45 2642           |                          |                              |                                  |
| $\frac{1}{3}$ | 53 9500           | 9643                     | 0055                         | - 6 35    | 1   | 45 2251           | 2345                     | 0043                         | - 4 49                           |
| 2             | 53 0979           |                          |                              |           |     |                   |                          |                              |                                  |
|               |                   |                          |                              |           |     |                   |                          |                              | Weighted mean . . . . . - 5 61   |
|               |                   |                          |                              |           |     |                   |                          |                              | $V_a$ . . . . . - 16 03          |
|               |                   |                          |                              |           |     |                   |                          |                              | $V_d$ . . . . . - 22             |
|               |                   |                          |                              |           |     |                   |                          |                              | Curvature . . . . . '28          |
|               |                   |                          |                              |           |     |                   |                          |                              | Radial velocity . . . . . - 22 1 |



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HERCULIS 1761.

1908, Aug. 5.  
G. M. T. 14<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKEC.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0351           |                          |                              |           | 2   | 53 1017           |                          |                              | ..        |
| 1   | 72 8896           | 8680                     | 0032                         | - 4 64    | 2   | 45 2597           |                          |                              | ..        |
| 2   | 72 4630           |                          |                              |           | 1½  | 45 2062           | 2201                     | 0186                         | 19 42     |
| 2   | 57 8205           |                          |                              |           | 1   | 27 3982           | 4028                     | 0098                         | 8 52      |
| 1½  | 57 8034           | 8123                     | 0145                         | 17 46     | 2   | 27 2120           |                          |                              | ..        |
| 2   | 54 7326           |                          |                              |           | 1½  | 11 8337           | 8494                     | 0020                         | 1 50      |
| 1½  | 53 9471           | 9554                     | 0144                         | 16 57     | 2   | 11 4915           |                          |                              | ..        |

Weighted mean ..... -12 04  
 $V_a$  ..... 16 25  
 $V_d$  ..... 08  
 Curvature ..... 28  
 Radial velocity ..... 28 6

HERCULIS 1774.

1908, Aug. 7.  
G. M. T. 15<sup>h</sup> 35<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 8210           |                          |                              |           | ½   | 45 2291           | 2317                     | 0070                         | - 7 31    |
| 1   | 57 8004           | 8088                     | 0180                         | - 21 67   | 1½  | 27 4238           | 4026                     | 0100                         | - 8 68    |
| 2   | 54 7319           |                          |                              |           | 2   | 27 2676           |                          |                              | ..        |
| ½   | 53 9647           | 9711                     | 0013                         | + 1 50    | 1½  | 11 8833           | 8514                     | 0000                         | 0 00      |
| 2   | 53 1063           |                          |                              |           | 2   | 11 5393           |                          |                              | ..        |
| 2   | 45 2710           |                          |                              |           |     |                   |                          |                              | ..        |

Weighted mean ..... 7 23  
 $V_a$  ..... 16 35  
 $V_d$  ..... 17  
 Curvature ..... 28  
 Radial velocity ..... -21 0

9-10 EDWARD VII., A. 1910

1908, Aug. 15,  
G. M. T. 16<sup>h</sup> 50<sup>m</sup>

ε HERCULIS 1782.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9712           |                          |                              |           | 2   | 53 9308           | 9566                     | 0132                         | - 15 19   |
| 1   | 72 8162           | 8545                     | 0103                         | - 14 94   | 2   | 53 0801           |                          |                              |           |
| 2   | 72 4052           |                          |                              |           | 2   | 45 2550           |                          |                              |           |
| 2   | 57 7983           |                          |                              |           | 2   | 45 2055           | 2241                     | 0146                         | - 15 24   |
| 1½  | 57 7814           | 8125                     | 0143                         | - 17 21   | 1   | 27 3902           | 3902                     | 0336                         | - 29 16   |
| 2   | 51 7181           |                          |                              |           | 2   | 27 2578           |                          |                              |           |

Weighted mean..... -17 44  
 $V_a$ ..... -17 09  
 $V_d$ ..... - 24  
 Curvature..... - 28  
 Radial velocity..... - 35 0

ε HERCULIS 1793.

1908, Aug. 19,  
G. M. T. 14<sup>h</sup> 41<sup>m</sup>

Observed by } W. E. HARPER.  
 Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 71 8997           |                          |                              |           | 1   | 66 5842           | 5905                     | 0873                         | - 37 19   |
| 1   | 71 8180           | 8198                     | 0673                         | - 29 58   | 2   | 61 4037           |                          |                              |           |
| 2   | 68 7255           |                          |                              |           | ½   | 61 1977           | 2033                     | 0412                         | - 16 93   |

Weighted mean..... -30 09  
 $V_a$ ..... -17 29  
 $V_d$ ..... - 15  
 Curvature..... - 28  
 Radial velocity..... - 47 8

ε HERCULIS 1818.

1908, Aug. 24,  
G. M. T. 14<sup>h</sup> 03<sup>m</sup>

Observed by } W. E. HARPER.  
 Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9400           |                          |                              |           | 1   | 53 0350           |                          |                              |           |
| 1   | 72 7367           | 8053                     | 0595                         | - 86 33   | 2   | 45 2000           |                          |                              |           |
| 2   | 72 3715           |                          |                              |           | 1½  | 45 1002           | 1737                     | 0650                         | - 67 86   |
| 2   | 54 6722           |                          |                              |           | 1   | 27 2776           | 3336                     | 0790                         | - 68 57   |
| 2   | 53 9557           |                          |                              |           | 2   | 27 1906           |                          |                              |           |
| 1   | 53 8285           | 9018                     | 0680                         | - 78 27   |     |                   |                          |                              |           |

Weighted mean..... -74 44  
 $V_a$ ..... -17 55  
 $V_d$ ..... - 15  
 Curvature..... - 28  
 Radial velocity..... - 92 4

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ε HERCULIS 1835.

1908. Aug. 27.  
G. M. T. 15<sup>h</sup> 50<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9994           |                          |                              |           | 2   | 45.2716           |                          |                              |           |
| 1   | 72.8367           | .8463                    | .0185                        | - 26.84   | 1   | 45.2345           | .2365                    | .0022                        | - 2.30    |
| 2   | 72.4383           |                          |                              |           | 1   | 27.4216           | .3991                    | .0135                        | - 11.72   |
| 2   | 57.8226           |                          |                              |           | 2   | 27.2694           |                          |                              |           |
| 1   | 57.8302           | .8344                    | .076                         | + 9.15    | 1   | 11.8840           | .8453                    | .0061                        | - 4.55    |
| 2   | 54.0265           |                          |                              |           | 2   | 11.5462           |                          |                              |           |
| 1½  | 54.9656           | .9679                    | .0019                        | - 2.19    |     |                   |                          |                              |           |

Weighted mean ..... - 5.82  
 $V_d$  ..... - 17.66  
 $V_d$  ..... - 24  
 Curvature ..... - 28  
 Radial velocity ..... - 24.0

ε HERCULIS 1844.

1908. Aug. 28.  
G. M. T. 14<sup>h</sup> 07<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0320           |                          |                              |           | 2   | 45.1750           | .1561                    | .0826                        | - 86.23   |
| ½   | 72.8382           | .8158                    | .0490                        | - 71.10   | ½   | 27.3755           | .3441                    | .0685                        | - 59.46   |
| 2   | 72.4677           |                          |                              |           | 2   | 27.2780           |                          |                              |           |
| 2   | 54.0522           |                          |                              |           | 1   | 11.7805           | .7394                    | .1120                        | - 82.79   |
| 1   | 53.9207           | .8973                    | .0725                        | - 81.45   | 2   | 11.5485           |                          |                              |           |
| 2   | 45.2925           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 80.80  
 $V_d$  ..... - 17.63  
 $V_d$  ..... - 16  
 Curvature ..... - 28  
 Radial velocity ..... - 98.9

ε HERCULIS 1853.

1908. Aug. 31.  
G. M. T. 13<sup>h</sup> 52<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.0330           |                          |                              |           | 1   | 45.2510           | .2530                    | .0143                        | + 14.93   |
| 2   | 53.9830           | .9788                    | .0100                        | + 11.51   | ½   | 27.4040           | .4166                    | .0040                        | + 3.47    |
| 2   | 45.2716           |                          |                              |           | 2   | 27.2340           |                          |                              |           |

Weighted mean ..... + 11.94  
 $V_d$  ..... - 17.63  
 $V_d$  ..... - 16  
 Curvature ..... - 28  
 Radial velocity ..... - 6.1

1908, Sept. 4,  
G. M. T. 14° 32'

HERCULIS 1866.

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 54 0286           |                          |                              |           | 2   | 45 2756           |                          |                              |           |
| 1½                   | 53 9682           | 9684                     | 0014                         | 2 03      | ¾   | 45 2387           | 2367                     | 0020                         | 2 09      |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | 2 05      |
| V <sub>a</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 17 56     |
| V <sub>d</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 22        |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | 20 1      |

1908, Oct. 1,  
G. M. T. 13° 12'

HERCULIS 1903.

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 72 9627           |                          |                              |           | 2   | 53 0938           |                          |                              |           |
| 2½                   | 72 8369           | 8850                     | 0202                         | 29 31     | 2   | 45 2707           |                          |                              |           |
| 2                    | 72 3935           |                          |                              |           | ¼   | 45 2698           | 2727                     | 0340                         | 35 96     |
| 2                    | 54 7217           |                          |                              |           | 2   | 43 5385           |                          |                              |           |
| ½                    | 53 9629           | 9891                     | 0121                         | 13 93     | 1   | 43 0812           | 0811                     | 0308                         | 31 38     |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | 28 39     |
| V <sub>a</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 13 38     |
| V <sub>d</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 23        |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | 14 3      |

1908, Oct. 1,  
G. M. T. 13° 12'

HERCULIS 1903.\*

Observed by W. E. HARPER.  
Measured by

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 57 8380           |                          |                              |           | 2   | 54 0527           |                          |                              |           |
| ¼                    | 57 8367           | 8255                     | 0113                         | 13 60     | ½   | 45 3017           | 2673                     | 0286                         | 31 95     |
| ¼                    | 53 0120           | 9881                     | 0183                         | 21 06     | 2   | 45 3080           |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | 22 17     |
| V <sub>a</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 13 38     |
| V <sub>d</sub> ..... |                   |                          |                              |           |     |                   |                          |                              | 23        |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | 8 1       |

\* Check measurement.

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HERCULIS 1905.

1908, Oct. 2,  
G. M. T. 12<sup>h</sup> 23<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9333           |                          |                              |           | $\frac{1}{2}$ | 53 9743           | 0083                     | 0385                         | 44.31     |
| $\frac{1}{2}$ | 72 8133           | 8888                     | 0240                         | 34.82     | 2             | 53 0845           |                          |                              |           |
| 2             | 72 3735           |                          |                              |           | 2             | 45 2615           |                          |                              |           |
| 2             | 54 7063           |                          |                              |           | $\frac{1}{2}$ | 45 2510           | 2631                     | 0244                         | +25.47    |

Weighted mean ..... +34.86  
 $V_a$  ..... 16.17  
 $V_d$  ..... 19  
 Curvature ..... 28  
 Radial velocity ..... +18.2

HERCULIS 1905.

1908, Oct. 2,  
G. M. T. 12<sup>h</sup> 23<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARRER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0219           |                          |                              |           | 1              | 54 0557           | 9920                     | 0222                         | +25.55    |
| $\frac{1}{2}$ | 72 9047           | 8923                     | 0275                         | +39.90    | 2              | 45 3540           |                          |                              |           |
| 2             | 72 4605           |                          |                              |           | $1\frac{1}{2}$ | 45 3672           | 2868                     | 0481                         | +50.22    |
| 2             | 54 0925           |                          |                              |           |                |                   |                          |                              |           |

Weighted mean ..... +40.28  
 $V_a$  ..... -16.17  
 $V_d$  ..... 19  
 Curvature ..... 28  
 Radial velocity ..... +23.6

\* Check measurement.

HERCULIS 1906.

1908, Oct. 2,  
G. M. T. 13<sup>h</sup> 18<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9878           |                          |                              |           | 2             | 45 2706           |                          |                              |           |
| $\frac{1}{2}$ | 72 8491           | 8716                     | 0068                         | +9.86     | 1             | 45 2536           |                          | 0179                         | +18.69    |
| 2             | 72 4218           |                          |                              |           | $\frac{1}{2}$ | 27 4469           | 3999                     | 0127                         | -11.02    |
| 2             | 54 7350           |                          |                              |           | 2             | 27 2936           |                          |                              |           |
| $\frac{1}{2}$ | 53 9915           | 9995                     | 0297                         | +34.18    | $\frac{1}{2}$ | 15 5485           | 4771                     | 0040                         | +2.93     |
| 2             | 53 1029           |                          |                              |           | 2             | 15 4700           |                          |                              |           |

Weighted mean ..... +12.22  
 $V_a$  ..... 16.17  
 $V_d$  ..... 23  
 Curvature ..... 28  
 Radial velocity ..... 4.4

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1908. Oct. 2.  
G. M. T. 13<sup>h</sup> 18<sup>m</sup>

## ε HERCULIS 1906.\*

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0126           |                          |                              |           | $\frac{1}{3}$ | 45.2729           | 2434                     | 0047                         | -4.81     |
| $\frac{1}{2}$ | 72.8790           | 8759                     | 0111                         | -16.11    | 2             | 45.3031           |                          |                              |           |
| 2             | 72.4515           |                          |                              |           | $\frac{1}{2}$ | 27.4884           | 4016                     | 0110                         | -9.55     |
| 2             | 54.0508           |                          |                              |           | 2             | 27.3237           |                          |                              |           |
| $\frac{1}{4}$ | 53.9882           | 9662                     | 0036                         | -4.14     |               |                   |                          |                              |           |

Weighted mean..... -1.15  
 $V_a$ ..... -16.17  
 $V_d$ ..... .23  
 Curvature..... .28  
 Radial velocity..... -15.5

\* Check measurement.

1908. Oct. 5  
G. M. T. 12<sup>h</sup> 45<sup>m</sup>

## ε HERCULIS 1917.

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 53.9338           |                          |                              |           | 1   | 53.9042           | 9992                     | 0294                         | +33.84    |

Weighted mean..... +33.84  
 $V_a$ ..... -13.21  
 $V_d$ ..... .22  
 Curvature..... .23  
 Radial velocity..... -18.1

1908. Oct. 12.  
G. M. T. 14<sup>h</sup> 15<sup>m</sup>

## ε HERCULIS 1926.

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54.7809           |                          |                              |           | 2             | 45.3392           |                          |                              |           |
| $\frac{1}{2}$ | 53.0112           | 6684                     | 0014                         | -1.61     | $\frac{1}{2}$ | 45.2745           | 2089                     | 0298                         | -31.11    |
| 2             | 53.1586           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean..... -16.36  
 $V_a$ ..... -12.99  
 $V_d$ ..... .28  
 Curvature..... .28  
 Radial velocity..... -29.9

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ε HERCULIS 1926.\*

1908, Oct. 12,  
G. M. T. 14<sup>h</sup> 15<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HALPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9282           |                          |                              |           | 1             | 53 9142           | 9648                     | 0050                         | 5 55      |
| $\frac{1}{2}$ | 72 7570           | 8283                     | 0265                         | 38 47     | 2             | 45 2412           |                          |                              |           |
| 2             | 72 3640           |                          |                              |           | $\frac{1}{2}$ | 45 1955           | 2281                     | 0106                         | -11 06    |
| 2             | 53 9777           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... 11 73  
 $V_a$  ..... -12 99  
 $V_d$  ..... - 28  
 Curvature ..... - 28  
 Radial velocity ..... -25 3

\* Check measurement.

ε HERCULIS 1961.

1908, Nov. 13,  
G. M. T. 10<sup>h</sup> 33<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9540           |                          |                              |           | $\frac{1}{2}$ | 45 1868           | 1763                     | 0725                         | 75 91     |
| $\frac{1}{2}$ | 72 7900           | 7980                     | 0207                         | -30 08    | 1             | 27 4600           | 4488                     | 0394                         | 34 36     |
| 2             | 72 3992           |                          |                              |           | 2             | 27 3340           |                          |                              |           |
| 2             | 54 0249           |                          |                              |           | $\frac{1}{2}$ | 11 8605           | 8626                     | 1378                         | -103 76   |
| 1             | 54 9106           | 9010                     | 0556                         | 61 16     | 2             | 11 6620           |                          |                              |           |
| 2             | 45 2941           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... -62 07  
 $V_a$  ..... 4 70  
 $V_d$  ..... - 23  
 Curvature ..... - 28  
 Radial velocity ..... -67 5

ε HERCULIS 1961.\*

1908, Nov. 13,  
G. M. T. 10<sup>h</sup> 33<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9915           |                          |                              |           | 2             | 48 8173           |                          |                              |           |
| $\frac{1}{2}$ | 72 8967           | 8233                     | 0415                         | -60 22    | $\frac{1}{2}$ | 48 1143           | 0670                     |                              |           |
| 2             | 72 4317           |                          |                              |           | 2             | 45 3301           |                          |                              |           |
| 2             | 54 7682           |                          |                              |           | 1             | 45 2254           | 1689                     | 0698                         | 72 87     |
| 1             | 53 9192           | 8912                     | 0603                         | 62 42     | 1             | 27 4192           | 3334                     | 0792                         | -67 74    |
| 2             | 53 1117           |                          |                              |           | 2             | 27 3324           |                          |                              |           |

Weighted mean ..... -66 75  
 $V_a$  ..... -4 69  
 $V_d$  ..... - 25  
 Curvature ..... - 28  
 Radial velocity ..... -71 8

\* Check measurement.

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1908, Nov. 15.  
G. M. T. 10<sup>h</sup> 33<sup>m</sup>

ε HERCULIS 1961.

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9300           |                          |                              |           | 2   | 53 0847           |                          |                              |           |
| 2   | 72 7524           | 7849                     | 0338                         | -48 11    | 2   | 45 2672           |                          |                              |           |
| 2   | 72 3700           |                          |                              |           | 1   | 45 1730           | 1894                     | 0593                         | 62 09     |
| 2   | 54 7057           |                          |                              |           | 1/2 | 11 8557           | 8791                     | 1213                         | -91 95    |
| 4   | 53 8622           | 8807                     | 0739                         | 87 59     | 2   | 11 6345           |                          |                              |           |

Weighted mean..... -68 24  
 $V_a$ ..... -4 70  
 $V_d$ ..... -23  
 Curvature..... -28

\* Check measurement.

Radial velocity..... -73 4

ε HERCULIS 1983.

1908, Nov. 26.  
G. M. T. 10<sup>h</sup> 07<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9887           |                          |                              |           | 2   | 53 1422           |                          |                              |           |
| 2   | 72 4267           |                          |                              |           | 2   | 45 3295           |                          |                              |           |
| 2   | 57 8410           |                          |                              |           | 1/2 | 45 2886           | 2237                     | 0250                         | -26 17    |
| 2   | 57 8284           | 7837                     | 0210                         | -25 32    | 2   | 27 3610           |                          |                              |           |
| 2   | 54 7670           |                          |                              |           | 2   | 11 6692           |                          |                              |           |
| 1   | 53 9637           | 9227                     | 0339                         | 39 12     |     |                   |                          |                              |           |

Weighted mean..... -29 54  
 $V_a$ ..... -79  
 $V_d$ ..... -25  
 Curvature..... -28

Radial velocity..... -30 9

ε HERCULIS 1993.

1908, Dec. 2.  
G. M. T. 11<sup>h</sup> 05<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0015           |                          |                              |           | 2   | 54 0327           | 9273                     | 0159                         | 18 28     |
| 1/2 | 72 8197           | 7353                     | 0368                         | -53 51    | 2   | 45 3945           |                          |                              |           |
| 2   | 72 4371           |                          |                              |           | 1   | 45 3182           | 2173                     | 0416                         | -43 68    |
| 2   | 54 1072           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -30 57  
 $V_a$ ..... + 1 12  
 $V_d$ ..... -28  
 Curvature..... -28

Radial velocity..... -30 0



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HERCULIS 2263.

1909, Feb. 8,  
G. M. T. 22<sup>h</sup> 08<sup>m</sup>

Observed by W. E. HARPER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 8987           |                          |                              |           | 1             | 45 2382           | 1897                     | 0692                         | 79 51     |
| $\frac{1}{2}$ | 72 7145           | 7305                     | 0416                         | -69 49    | $\frac{1}{2}$ | 27 5582           | 5058                     | 0560                         | 49 56     |
| 2             | 72 3414           |                          |                              |           | 2             | 27 4495           |                          |                              |           |
| 2             | 54 0360           |                          |                              |           | $\frac{1}{2}$ | 12 1170           | 1096                     | 0391                         | -29 56    |
| 1             | 53 9235           | 8891                     | 0541                         | 62 57     | 2             | 11 8145           |                          |                              |           |
| 2             | 45 3421           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 60 54  
 $V_a$ ..... - 17 19  
 $V_d$ ..... - 16  
 Curvature..... - 28  
 Radial velocity ..... - 43 5

HERCULIS 2264.

1909, Feb. 8,  
G. M. T. 23<sup>h</sup>

Observed by W. E. HARPER.  
Measured by

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 8680           |                          |                              |           | 1   | 45 2202           | 2118                     | 0471                         | -54 12    |
| $\frac{1}{2}$ | 72 6942           | 7400                     | 0321                         | -46 67    | 1   | 27 5152           | 5061                     | 0551                         | -49 29    |
| 1             | 72 3157           |                          |                              |           | 2   | 27 4062           |                          |                              |           |
| 2             | 54 0053           |                          |                              |           | 1   | 12 0368           | 0711                     | 0776                         | -58 66    |
| $\frac{1}{2}$ | 53 8918           | 8878                     | 0554                         | -64 07    | 2   | 11 7743           |                          |                              |           |
| 2             | 45 3020           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 56 30  
 $V_a$ ..... - 17 19  
 $V_d$ ..... - 12  
 Curvature..... - 28  
 Radial velocity ..... - 39 3

ε HERCULIS 2305.

1909. Feb. 22.  
G. M. T. 21<sup>h</sup> 34<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9872           | .....                    | .....                        | .....     | 1   | 53 9658           | 9111                     | 0321                         | - 37.13   |
| 2   | 72 8275           | 7571                     | 0150                         | - 21.81   | 2   | 45 3275           | .....                    | .....                        | .....     |
| 2   | 72 4233           | .....                    | .....                        | .....     | 1   | 45 2636           | 2295                     | 0291                         | - 30.87   |
| 2   | 57 8428           | .....                    | .....                        | .....     | 1   | 27 4794           | 4953                     | 0665                         | - 58.22   |
| 1   | 57 8125           | 7522                     | 0303                         | - 36.63   | 2   | 27 3812           | .....                    | .....                        | .....     |
| 2   | 54 0565           | .....                    | .....                        | .....     |     |                   |                          |                              |           |

Weighted mean ..... - 36.09  
 $V_{\text{a}}$  ..... - 17.95  
 $V_{\text{z}}$  ..... + 15  
 Curvature ..... - .28  
 Radial velocity ..... - 18.2

ε HERCULIS 2306.

1909. Feb. 22.  
G. M. T. 22<sup>h</sup> 36<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9687           | .....                    | .....                        | .....     | 2   | 45 3155           | .....                    | .....                        | .....     |
| 1   | 72 8071           | 7544                     | 0177                         | - 25.74   | 1   | 45 2637           | 2415                     | 0174                         | - 18.27   |
| 1   | 72 4002           | .....                    | .....                        | .....     | 1   | 27 5020           | 5276                     | 0342                         | - 29.93   |
| 2   | 57 7942           | .....                    | .....                        | .....     | 2   | 27 3725           | .....                    | .....                        | .....     |
| 2   | 57 8290           | 7477                     | 0348                         | - 42.05   | 1   | 11 9835           | 0905                     | 0582                         | - 41.00   |
| 2   | 54 0450           | .....                    | .....                        | .....     | 2   | 11 7002           | .....                    | .....                        | .....     |
| 1   | 53 9530           | 9100                     | 0332                         | - 38.40   |     |                   |                          |                              |           |

Weighted mean ..... - 34.12  
 $V_{\text{a}}$  ..... - 17.95  
 $V_{\text{z}}$  ..... + 10.09  
 Curvature ..... - .28  
 Radial velocity ..... - 16.4

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ε HERCULIS 2327.

1909. March 2.  
G. M. T. 21<sup>h</sup> 12<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 3387           |                          |                              |           | 2     | 45 2988           |                          |                              |           |
| 2   | 72 8030           | 7800                     | 0079                         | +11 49    | 1 1/2 | 45 3043           | 2991                     | 0402                         | +42 21    |
| 2   | 72 3801           |                          |                              |           | 2     | 12 6685           | 1891                     | 0404                         | +30 51    |
| 2   | 54 0227           |                          |                              |           | 2     | 11 6875           |                          |                              |           |
| 2   | 53 9890           | 9681                     | 0249                         | +28 70    |       |                   |                          |                              |           |

Weighted mean ..... +31 76  
 $V_a$  ..... +17 90  
 $V_d$  ..... + 14  
 Curvature ..... - 28  
 Radial velocity ..... + 49 5

ε HERCULIS 2328.

1909. March 2.  
G. M. T. 22<sup>h</sup> 26<sup>m</sup>

Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 53 9935           |                          |                              |           | 2     | 45 2644           |                          |                              |           |
| 1   | 53 9260           | 9343                     | 0091                         | -10 52    | 1 1/2 | 45 2350           | 2642                     | 0053                         | + 5 56    |

Weighted mean ..... 5 16  
 $V_a$  ..... +17 90  
 $V_d$  ..... - 05  
 Curvature ..... - 28  
 Radial velocity ..... + 12 5

ε HERCULIS 2370\*.

1909. March 13.  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 50 9370           |                          |                              |           | 1/2 | 34 7430           | 34 7193                  | 0038                         | -100 00   |
| 1   | 50 8242           | 8081                     | 0804                         | -93 05    | 2   | 34 6975           |                          |                              |           |

Weighted mean ..... -95 36  
 $V_a$  ..... +17 44  
 $V_d$  ..... - 19  
 Curvature ..... - 30  
 Radial velocity ..... - 78 0

\* This plate and all following were taken by the new single-prism Spectroscope.

$\epsilon$  HERCULIS 2371.

1909. March 13.  
G. M. T. 19<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 58 8462           |                          |                              |           | 1             | 50 8549           | 8347                     | 0538                         | -62.27    |
| $\frac{1}{4}$ | 58 7184           | 6911                     | 0741                         | -94.51    | $\frac{1}{2}$ | 34 7589           | 7401                     | 0820                         | -79.00    |
| 2             | 50 9411           |                          |                              |           | 2             | 34 6926           |                          |                              |           |

Weighted mean..... -71.66  
 $V_a$ ..... +17.44  
 $V_d$ ..... +19  
 Curvature..... -30  
 Radial velocity..... -54.3

$\epsilon$  HERCULIS 2384.

1909. March 15.  
G. M. T. 19<sup>h</sup> 32<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 58 8228           |                          |                              |           | 2             | 50 9196           |                          |                              |           |
| $\frac{1}{4}$ | 58 7768           | 7729                     | 0077                         | -9.82     | $\frac{1}{2}$ | 50 9081           | 9094                     | 0209                         | -24.19    |

Weighted mean..... -19.40  
 $V_a$ ..... -17.16  
 $V_d$ ..... +18  
 Curvature..... -30  
 Radial velocity..... -36.4

$\epsilon$  HERCULIS 2385.

1909. March 15.  
G. M. T. 20<sup>h</sup> 30<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 58 8349           |                          |                              |           | 1             | 50 9261           | 9091                     | 0206                         | -23.84    |
| $\frac{1}{4}$ | 58 7924           | 7764                     | 0112                         | +14.29    | $\frac{1}{2}$ | 34 8678           | 8413                     | 0192                         | +18.50    |
| 2             | 50 9379           |                          |                              |           | 2             | 34 7093           |                          |                              |           |

Weighted mean..... +21.36  
 $V_a$ ..... -17.16  
 $V_d$ ..... -18  
 Curvature..... -30  
 Radial velocity..... +38.4

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ε HERCULIS 2451.

1909. March 21.  
G. M. T. 20<sup>h</sup> 05<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 58.8306           | .....                    | .....                        | .....     | 1             | 50.9084           | 9991                     | 0206                         | +23.84    |
| $\frac{1}{2}$ | 58.7836           | 7720                     | 0068                         | +8.67     | $\frac{1}{2}$ | 34.7592           | 8274                     | 0053                         | +5.11     |
| 2             | 50.9202           | .....                    | .....                        | .....     | 2             | 34.6456           | .....                    | .....                        | .....     |

Weighted mean..... +15.34  
 $V_a$ ..... -14.93  
 $V_d$ ..... - .06  
 Curvature..... - .30  
 Radial velocity..... -30.0

ε HERCULIS 2455.

1909. March 31.  
G. M. T. 20<sup>h</sup> 39<sup>m</sup>

Observed by J. B. CANNON.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 58.8294           | .....                    | .....                        | .....     | 1             | 59.9111           | 9991                     | 0206                         | +23.84    |
| $\frac{1}{2}$ | 58.8022           | 7917                     | 0265                         | +33.80    | $\frac{1}{2}$ | 34.7789           | 8005                     | 0216                         | -20.90    |
| 2             | 50.9229           | .....                    | .....                        | .....     | 2             | 34.6522           | .....                    | .....                        | .....     |

Weighted mean..... +15.15  
 $V_a$ ..... +14.93  
 $V_d$ ..... + .06  
 Curvature..... - .30  
 Radial velocity..... +29.8

OBSERVING RECORD AND DETAILED MEASURES OF  $\eta$  BOÖTIS.

P.—PLASKETT.  
Pl.—PARKER.  
H.—HARPER.  
C.—CANNON.  
T.—TRIBBLE.

RECORD OF SPECTROGRAMS.

| Star.          | No. of Negative. | Camera. | Plate. | Date.   | Middle of Exposure.<br>G. M. T. |        | Duration. | Hour<br>Angle<br>at end. | TEMPERATURE. |        |            |       | Slit<br>Width.     | Seeing. | Observer. |
|----------------|------------------|---------|--------|---------|---------------------------------|--------|-----------|--------------------------|--------------|--------|------------|-------|--------------------|---------|-----------|
|                |                  |         |        |         |                                 |        |           |                          | Room.        |        | Prism Box. |       |                    |         |           |
|                |                  |         |        |         |                                 |        |           |                          | Beg.         | End.   | Beg.       | End.  |                    |         |           |
|                |                  |         |        | 1906.   | h. m.                           | m.     | h. m.     | Fahreheit.               | Centi.       | grade. |            |       |                    |         |           |
| $\eta$ Boötis. | 308              | HL      | Seed   | 27 June | 25 15                           | 55 35  | 3 30W.    | 65 0                     | 64 0         | 22 7   | 22 8       | .001  | Poor ...           | P       |           |
| "              | 313              | "       | "      | "       | 27 14                           | 35 35  | 2 15W.    | 75 6                     | 74 0         | 27 1   | 27 0       | .001  | Fair....           | P       |           |
| "              | 318c             | "       | "      | "       | 29 14                           | 21 18  | 2 10W.    | 77 4                     | 76 2         | 27 0   | 27 0       | .0009 | " ..               | P       |           |
| "              | 326              | "       | "      | July    | 4 14                            | 50 60  | 3 15W.    | 62 5                     | 60 9         | 21 3   | 21 4       | .001  | Fair to<br>good .. | P       |           |
| "              | 333              | "       | "      | "       | 6 15                            | 00 70  | 3 40W.    | 71 5                     | 68 0         | 25 3   | 25 4       | .001  | Fair....           | P       |           |
| "              | 366              | "       | "      | Aug.    | 6 14                            | 05 70  | 4 45W.    | 78 0                     | 74 0         | 28 8   | 28 8       | .001  | Good....           | P       |           |
| "              | 372              | "       | "      | "       | 8 14                            | 15 75  | 5 10W.    | 80 8                     | 77 5         | 29 5   | 29 3       | .001  | Fair....           | P       |           |
|                |                  |         |        | 1907.   |                                 |        |           |                          |              |        |            |       |                    |         |           |
| "              | 657              | "       | "      | Mar.    | 8 18                            | 45 30  | 50E.      | 26 5                     | 25 6         | 1 3    | 1 5        | .0013 | Fair....           | P       |           |
| "              | 670              | "       | "      | "       | 20 18                           | 32 45  | 10E.      | 28 6                     | 28 3         | 2 8    | 2 9        | .0013 | Good....           | P       |           |
| "              | 691              | "       | "      | Apr.    | 3 18                            | 02 35  | 15W.      | 44 0                     | 40 2         | 9 8    | 10 1       | .001  | Poor ...           | P       |           |
| "              | 731              | "       | "      | "       | 19 18                           | 35 10  | 1 37W.    | 34 8                     | 34 5         | 10 4   | 10 4       | .0013 | Clouds ..          | P       |           |
| "              | 739              | "       | "      | "       | 26 17                           | 30 30  | 1 07W.    | 42 0                     | 40 4         | 9 0    | 9 0        | .0013 | Fair....           | P       |           |
| "              | 752              | "       | "      | May     | 7 14                            | 20 20  | 1 30E.    | 50 5                     | 50 0         | 16 1   | 16 1       | .0013 | " ..               | H       |           |
| "              | 760              | 11HL    | "      | "       | 14 17                           | 55 34  | 2 05W.    | 11 7                     | 11 7         | 15 0   | 15 0       | .0012 | Very<br>poor...    | H       |           |
| "              | 764              | "       | "      | "       | 20 16                           | 25 55  | 1 45W.    | 6 0                      | 5 3          | 9 2    | 9 2        | .0012 | Unst'dy            | H       |           |
| "              | 769              | "       | "      | "       | 22 16                           | 51 47  | 2 20W.    | 10 5                     | 10 5         | 13 2   | 13 2       | .0012 | Cloudy.            | P       |           |
| "              | 774              | 1L      | "      | "       | 23 11                           | 08 16  | 37E.      | 15 5                     | 15 0         | 17 3   | 17 3       | .0012 | Fair....           | H       |           |
| "              | 779              | "       | "      | "       | 24 15                           | 01 12  | 20W.      | 11 8                     | 12 0         | 16 4   | 16 4       | .001  | Good....           | P       |           |
| "              | 793              | "       | "      | "       | 29 16                           | 46 27  | 2 30W.    | 8 0                      | 8 0          | 14 5   | 14 5       | .001  | Cloudy.            | P       |           |
| "              | 797              | "       | "      | "       | 31 14                           | 54 12  | 45W.      | 15 2                     | 15 2         | 19 0   | 19 0       | .001  | Good....           | P       |           |
| "              | 812              | "       | "      | June    | 10 13                           | 35 35  | 1 48W.    | 16 6                     | 15 6         | 18 2   | 18 0       | .0009 | " ..               | P       |           |
| "              | 868              | "       | "      | "       | 21 14                           | 27 25  | 1 40W.    | 25 4                     | 24 6         | 28 9   | 28 9       | .001  | Hazy ..            | P       |           |
| "              | 891              | "       | "      | "       | 27 14                           | 55 30  | 2 35W.    | 22 0                     | 22 0         | 24 5   | 24 5       | .0012 | Fair....           | H       |           |
| "              | 918              | "       | "      | July    | 8 15                            | 09 18  | 3 30W.    | 21 5                     | 21 1         | 22 4   | 22 4       | .0012 | " ..               | P       |           |
| "              | 950              | "       | "      | "       | 18 13                           | 57 26  | 3 00W.    | 27 0                     | 26 0         | 28 5   | 28 5       | .0012 | Very<br>hazy..     | T       |           |
| "              | 972              | "       | "      | Aug.    | 1 13                            | 39 25  | 3 37W.    | 22 2                     | 21 0         | 25 2   | 25 2       | .001  | Hazy ..            | H       |           |
| "              | 990              | 111L    | "      | "       | 7 13                            | 58 50  | 4 30W.    | 23 1                     | 22 0         | 24 1   | 24 1       | .0015 | Poor ...           | P       |           |
|                |                  |         |        | 1908.   |                                 |        |           |                          |              |        |            |       |                    |         |           |
| "              | 1231             | 1L      | "      | Jan.    | 14 22                           | 00 26  | 1 10E.    | -16 5                    | -18 0        | - 5 2  | - 5 5      | .001  | Hazy...            | H       |           |
| "              | 1294             | 111L    | "      | "       | 27 20                           | 12 50  | 1 52E.    | -20 0                    | -18 0        | -15 3  | -15 3      | .0013 | Good....           | H       |           |
| "              | 1307             | "       | "      | "       | 29 21                           | 14 62  | 1 07E.    | -25 3                    | -25 5        | -13 7  | -13 7      | .0013 | Unst'dy            | P       |           |
| "              | 1332             | "       | "      | Feb.    | 17 22                           | 30 40  | 1 45W.    | -17 5                    | -18 0        | -10 5  | -10 5      | .0015 | Good....           | P       |           |
| "              | 1357             | "       | "      | "       | 24 19                           | 06 47  | 1 20E.    | -16 5                    | -15 5        | -19 0  | -18 6      | .0013 | Unst'dy            | H       |           |
| "              | 1416             | "       | "      | Mar.    | 30 20                           | 52 40  | 3 50W.    | 0 5                      | 0 5          | 6 0    | 6 0        | .002  | Fair....           | H       |           |
| "              | 1513             | "       | "      | "       | 4 18                            | 13 55  | 2 40W.    | 8 0                      | 7 0          | 13 4   | 13 3       | .0017 | Good ..            | PH      |           |
| "              | 1553             | "       | "      | "       | 25 15                           | 58 64  | 1 50W.    | 21 3                     | 20 5         | 25 6   | 25 4       | .0016 | " ..               | P       |           |
| "              | 1557             | "       | "      | "       | 23 16                           | 00 50  | 1 45W.    | 21 5                     | 20 7         | 25 7   | 25 6       | .0015 | Fair....           | P       |           |
| "              | 1621             | "       | "      | June    | 22 14                           | 10 30  | 2 35W.    | 20 0                     | 19 6         | 24 0   | 23 8       | .0015 | " ..               | P       |           |
| "              | 1663             | "       | "      | July    | 6 14                            | 40 80  | 3 25W.    | 25 3                     | 24 8         | 26 8   | 26 3       | .0015 | Good....           | P       |           |
| "              | 1710             | "       | "      | "       | 15 14                           | 41 102 | 4 11W.    | 19 5                     | 18 0         | 21 8   | 21 6       | .0015 | Cloudy.            | C       |           |
| "              | 1792             | "       | "      | Aug.    | 19 13                           | 18 60  | 4 47W.    | 18 8                     | 16 5         | 24 3   | 23 8       | .0018 | Good....           | H       |           |
| "              | 1867             | "       | "      | Sept.   | 7 12                            | 57 65  | 5 40W.    | 18 2                     | 17 6         | 21 4   | 21 2       | .0015 | Fair....           | P       |           |
|                |                  |         |        | 1909.   |                                 |        |           |                          |              |        |            |       |                    |         |           |
| "              | 2115             | "       | "      | Jan.    | 7 23                            | 23 60  | 10W.      | -20 0                    | -20 5        | -13 6  | -13 6      | .0016 | Fair....           | P       |           |
| "              | 2209             | "       | "      | "       | 30 18                           | 37 45  | 3 20E.    | - 8 3                    | - 8 5        | - 2 8  | - 2 9      | .0016 | Unst'dy            | P       |           |
| "              | 2283             | "       | "      | Feb.    | 17 20                           | 30 62  | 00        | -12 0                    | -12 0        | - 1 3  | - 1 3      | .0015 | Good....           | C       |           |
| "              | 2396             | "       | "      | Mar.    | 20 17                           | 00 60  | 1 30E.    | - 2 3                    | - 3 3        | 4 6    | 4 6        | .0015 | Fair....           | P       |           |

SESSIONAL PAPER No. 25a

1906. June 25.  
G. M. T. 15<sup>h</sup> 55<sup>m</sup>

$\eta$  BOÖTIS 308.

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 3   | 65 1415           | 4583 661              | .....                  | .....               | .....                        | .....     | 1.  | 46 0370           | 4376 165              | .....                  | .....               | .....                        | .....     |
| 2   | 62 3546           | 4550 101              | 165                    | 766                 | 399                          | 26 28     | 1.  | 45 4280           | 4370 332              | 276                    | 856                 | 420                          | 30 61     |
| 1   | 60 7590           | 4531 441              | 473                    | 201                 | 372                          | 17 99     | 1.  | 41 8841           | 4337 216              | .....                  | .....               | .....                        | .....     |
| 1   | 60 5605           | 4529 147              | 171                    | 807                 | 361                          | 24 10     | 1   | 39 8944           | 4319 219              | 191                    | 817                 | 374                          | 38 64     |
| 1   | 60 0525           | 4523 302              | 318                    | 055                 | 263                          | 17 43     | 1   | 39 7019           | 4317 527              | 503                    | 068                 | 455                          | 30 21     |
| 1   | 57 5179           | 4494 721              | .....                  | .....               | .....                        | .....     | 1.  | 39 4517           | 4315 298              | .....                  | .....               | .....                        | .....     |
| 1   | 54 9606           | 4466 816              | .....                  | .....               | .....                        | .....     | 2   | 39 1909           | 4315 620              | 600                    | 178                 | 422                          | 29 33     |
| 1   | 54 2971           | 4459 723              | 651                    | 304                 | 347                          | 23 32     | 2   | 37 6639           | 4294 322              | .....                  | .....               | .....                        | .....     |
| 1   | 54 2635           | 4459 366              | .....                  | .....               | .....                        | .....     | 3   | 33 1023           | 4260 796              | 820                    | 503                 | 317                          | 22 30     |
| 1   | 53 8823           | 4435 320              | 210                    | 962                 | 278                          | 18 71     | 1   | 29 7582           | 4233 629              | 685                    | 462                 | 223                          | 15 79     |
| 1   | 51 2524           | 4427 927              | 855                    | 420                 | 435                          | 29 45     | 1   | 31 9013           | 4250 924              | 972                    | 643                 | 329                          | 23 21     |
| 1   | 49 0101           | 4405 271              | 199                    | 951                 | 320                          | 21 78     | 2   | 22 9884           | 4181 569              | .....                  | .....               | .....                        | .....     |

Weighted mean ..... +23 08

$V_a$  ..... -24 87

$V_d$  ..... -25

Curvature ..... -28

Radial velocity ..... -2 3

1906. June 27.  
G. M. T. 14<sup>h</sup> 35<sup>m</sup>

$\eta$  BOÖTIS 313.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 70 0228           | 4549 704              | .....                  | .....               | .....                        | .....     | 1   | 58 7715           | 4425 974              | 982                    | 608                 | 374                          | 25 31     |
| 2   | 70 0646           | 4550 199              | 113                    | 766                 | 377                          | +24 84    | 2   | 57 7472           | 4415 579              | 571                    | 244                 | 327                          | 22 20     |
| 2   | 68 8922           | 4536 420              | 408                    | 965                 | 443                          | 29 28     | 2   | 56 7110           | 4405 198              | 194                    | 951                 | 243                          | 16 80     |
| 1   | 68 4773           | 4531 556              | 552                    | 202                 | 350                          | 23 13     | 3   | 56 6837           | .....                 | .....                  | .....               | .....                        | .....     |
| 1   | 68 3445           | 4530 057              | 057                    | 781                 | 273                          | 18 04     | 2   | 55 7498           | 4395 689              | 696                    | 286                 | 410                          | 27 96     |
| 2   | 68 2790           | 4529 300              | 297                    | 807                 | 490                          | 32 38     | 1   | 54 5449           | 4383 928              | 970                    | 720                 | 250                          | 17 07     |
| 3   | 68 2356           | .....                 | .....                  | .....               | .....                        | .....     | 1   | 51 5162           | 4383 650              | .....                  | .....               | .....                        | .....     |
| 1   | 67 7616           | 4523 337              | 345                    | 855                 | 490                          | 32 35     | 1   | 53 1281           | 4370 320              | 356                    | 856                 | 500                          | 31 30     |
| 3   | 65 2295           | 4494 746              | .....                  | .....               | .....                        | .....     | 1   | 52 9142           | 4368 285              | 320                    | 840                 | 480                          | 32 92     |
| 1   | 64 1575           | 4482 928              | 924                    | 434                 | 490                          | 32 88     | 2   | 51 2105           | 4352 272              | 312                    | 006                 | 366                          | 21 08     |
| 1   | 63 5802           | 4476 631              | 631                    | 214                 | 420                          | 28 09     | 3   | 48 3264           | 4325 902              | .....                  | .....               | .....                        | .....     |
| 2   | 63 5399           | 4476 193              | .....                  | .....               | .....                        | .....     | 2   | 47 8181           | 4321 348              | 368                    | 992                 | 376                          | 26 05     |
| 1   | 63 2805           | 4473 381              | 377                    | 957                 | 420                          | 28 10     | 2   | 47 1641           | 4315 529              | 545                    | 178                 | 367                          | 25 46     |
| 2   | 62 6605           | 4466 698              | .....                  | .....               | .....                        | .....     | 3   | 46 3197           | .....                 | .....                  | .....               | .....                        | .....     |
| 2   | 59 7122           | 4435 639              | 654                    | 184                 | 470                          | 31 77     | 1   | 46 3142           | 4308 296              | 296                    | 023                 | 273                          | 18 97     |
| 1   | 58 9422           | 4427 719              | 730                    | 420                 | 310                          | 20 98     | 2   | 46 1418           | 4306 521              | 513                    | 153                 | 360                          | +25 02    |

Weighted mean ..... +25 87

$V_a$  ..... -25 19

$V_d$  ..... 14

Curvature ..... 50

Radial velocity ..... 0 0

1906. June 29.  
G. M. T. 14<sup>h</sup> 21<sup>m</sup>

$\eta$  BOÖTIS 318c.

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 65.1913           | 4584.018              |                        |                     |                              |           | 14  | 46.8204           | 4383.596              |                        |                     |                              |           |
| 2   | 62.3803           | 4550.121              | .205                   | .766                | .439                         | +28.93    | 1   | 45.5865           | 4371.738              | .806                   | .312                | .494                         | 29.78     |
| 2   | 62.3321           | 4549.552              |                        |                     |                              |           | 1   | 45.4158           | 4370.111              | .177                   | .856                | .321                         | 22.03     |
| 1   | 60.7998           | 4531.584              | .664                   | .202                | .462                         | 30.59     | 1   | 45.2187           | 4368.238              | .302                   | .840                | .462                         | 31.84     |
| 1   | 60.5480           | 4528.712              |                        |                     |                              |           | 3   | 42.2886           | 4340.901              | .941                   | .634                | .307                         | 21.29     |
| 1   | 60.0766           | 4523.289              | .377                   | .855                | .522                         | 34.61     | 1   | 39.4436           | 4315.255              |                        |                     |                              |           |
| 1   | 57.5359           | 4494.635              |                        |                     |                              |           | 1   | 38.6660           | 4308.394              | .390                   | .023                | .367                         | 25.58     |
| 1   | 54.2713           | 4459.185              |                        |                     |                              |           | 3   | 37.0462           | 4294.299              |                        |                     |                              |           |
| 1   | 53.9012           | 4455.264              | .384                   | .962                | .422                         | 28.40     | 1   | 35.7398           | 4283.122              | .106                   | .721                | .385                         | 26.95     |
| 1   | 51.5610           | 4430.869              | .985                   | .678                | .307                         | 20.78     | 1   | 33.0517           | 4260.643              |                        |                     |                              |           |
| 2   | 50.0623           | 4415.601              | .709                   | .293                | .416                         | 28.25     | 1   | 28.9306           | 4227.475              | .463                   | .010                | .453                         | 32.12     |
| 14  | 50.0089           | 4415.084              |                        |                     |                              |           | 1   | 25.2131           | 4198.823              | .819                   | .403                |                              | +23.78    |
| 2   | 49.0242           | 4405.227              | .331                   | .951                | .380                         | 25.87     | 2   | 22.9474           | 4181.919              |                        |                     |                              |           |
| 1   | 46.8536           | 4383.917              | .001                   | .720                | .281                         | 20.02     |     |                   |                       |                        |                     |                              |           |

Weighted mean ..... + 27.55  
 $V_a$  ..... - 25.31  
 $V_d$  ..... .14  
 Curvature..... - .23

Radial velocity ..... + 1.8

1906. July 4.  
G. M. T. 14<sup>h</sup> 50<sup>m</sup>

$\eta$  BOÖTIS 326.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 47.9535           | 4321.280              | .292                   | .992                | .300                         | -20.97    | 1   | 62.1243           | 4459.686              | .724                   | .304                | .420                         | 28.22     |
| 2   | 72.9821           | 4584.067              |                        |                     |                              |           | 1   | 61.7085           | 4455.266              | .300                   | .962                | .338                         | 22.74     |
| 1   | 72.0410           | 4572.552              | .528                   | .156                | .372                         | 24.32     | 1   | 61.3025           | 4450.975              | .097                   | .654                | .443                         | 29.81     |
| 2   | 70.1726           | 4550.127              | .196                   | .766                | .360                         | 23.68     | 1   | 59.0672           | 4427.735              | .743                   | .420                | .323                         | 21.86     |
| 2S  | 70.1316           |                       |                        |                     |                              |           | 2   | 57.8787           | 4415.645              | .638                   | .293                | .345                         | 23.42     |
| 2   | 68.9985           | 4536.325              | .325                   | .965                | .360                         | 23.79     | 1   | 56.8425           | 4405.249              | .251                   | .951                | .300                         | 20.43     |
| 1   | 68.3839           | 4529.186              | .187                   | .807                | .380                         | 25.15     | 3S  | 56.8102           |                       |                        |                     |                              |           |
| 3   | 68.3512           | 4528.807              |                        |                     |                              |           | 2   | 55.8790           | 4395.702              | .710                   | .286                | .424                         | 28.91     |
| 1   | 67.8621           | 4523.173              | .165                   | .855                | .310                         | 20.55     | 3   | 54.6865           | 4384.041              | .060                   | .720                | .340                         | 23.25     |
| 2   | 65.9783           | 4501.798              | .786                   | .448                | .338                         | 22.47     | 2   | 54.6501           | 4383.688              |                        |                     |                              |           |
| 3   | 65.3427           | 4494.706              |                        |                     |                              |           | 2   | 53.4072           | 4371.721              | .752                   | .312                | .440                         | 30.18     |
| 2   | 63.6949           | 4476.593              | .584                   | .214                | .370                         | 24.75     | 1   | 53.0457           | 4368.273              | .300                   | .840                | .460                         | 31.55     |
| 2   | 63.6582           | 4476.195              |                        |                     |                              |           | 2   | 51.3477           | 4352.284              | .308                   | .066                | .302                         | 20.80     |
| 2   | 63.3995           | 4473.387              | .407                   | .957                | .450                         | 30.15     | 3   | 50.1222           | 4340.944              | .960                   | .631                | .326                         | 22.40     |
| 1   | 62.7750           | 4466.648              |                        |                     |                              |           | 3   | 48.4705           | 4325.922              |                        |                     |                              |           |
| 1   | 62.8070           | 4466.982              | .061                   | .771                | .290                         | 19.45     | 3   | 47.3080           | 4315.523              | .523                   | .178                | .345                         | +23.94    |
| 2   | 62.6324           | 4465.118              | .158                   | .712                | .446                         | 29.92     | 3S  | 46.4662           |                       |                        |                     |                              |           |

Weighted mean ..... + 24.70  
 $V_a$  ..... - 25.68  
 $V_d$  ..... .21  
 Curvature..... - .50

Radial velocity ..... - 1.7



SESSIONAL PAPER No. 25a

η BOÖTIS 333.

1906. July 6.  
G. M. T. 15<sup>h</sup> 0<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 3     | 65 1677           | 4584 687              |                        |                     |                              |           | 2     | 49 0105           | 4195 903              | 327                    | 951                 | 376                          | 25 60     |
| 1     | 64 2090           | 4572 978              | 370                    | 156                 | 214                          | -14 03    | 2     | 49 9783           | 4415 602              |                        |                     |                              |           |
| 2     | 62 3521           | 4550 733              | 149                    | 766                 | 383                          | 25 23     | 1     | 46 8362           | 4384 534              | 958                    | 720                 | 238                          | 16 28     |
| 2     | 62 3108           | 4550 244              |                        |                     |                              |           | 1     | 46 0199           | 4376 656              |                        |                     |                              |           |
| 1 1/2 | 60 7739           | 4532 258              | 690                    | 202                 | 183                          | 32 27     | 2     | 45 2045           | 4368 866              | 298                    | 840                 | 458                          | 31 43     |
| 1 1/2 | 60 5228           | 4529 354              |                        |                     |                              |           | 2     | 42 2765           | 4311 599              | 949                    | 634                 | 315                          | 21 66     |
| 2     | 57 5196           | 4495 363              |                        |                     |                              |           | log   | 39 4279           | 4315 792              |                        |                     |                              |           |
| 1 1/2 | 54 8062           | 4465 776              | 200                    | 972                 | 228                          | 15 31     | 2     | 38 6559           | 4308 969              | 425                    | 023                 | 402                          | 29 97     |
| 1     | 54 5412           | 4462 942              | 366                    | 977                 | 389                          | 26 15     | 2     | 37 6232           | 4299 954              |                        |                     |                              |           |
| 1     | 54 2531           | 4459 893              |                        |                     |                              |           | 1     | 37 0706           | 4295 148              | 620                    | 273                 | 347                          | 24 22     |
| 2     | 53 8852           | 4455 966              | 390                    | 962                 | 428                          | 22 07     | 2     | 33 0446           | 4261 155              |                        |                     |                              |           |
| 1     | 53 4774           | 4451 659              | 079                    | 597                 | 482                          | 32 45     | 2     | 33 0766           | 4261 419              | 923                    | 523                 | 400                          | 28 14     |
| 2     | 51 5374           | 4431 472              | 888                    | 678                 | 210                          | 14 21     | 1 1/2 | 28 9090           | 4227 803              | 371                    | 010                 | 361                          | 25 59     |
| 2     | 51 2451           | 4428 473              | 893                    | 420                 | 473                          | 32 02     | 2     | 24 3115           | 4192 463              | 103                    | 678                 | 425                          | +30 37    |
| 1 1/2 | 51 0727           | 4426 719              | 135                    | 805                 | 330                          | 22 37     | 2     | 22 9368           | 4182 232              |                        |                     |                              |           |
| 2     | 50 0457           | 4416 282              | 702                    | 193                 | 409                          | 27 76     |       |                   |                       |                        |                     |                              |           |

Weighted mean..... -24 60  
 $V_a$  ..... -25 76  
 $V_d$  ..... 21  
 Curvature..... 28  
 Radial velocity..... - 17

η BOÖTIS 366.

1906. Aug. 6.  
G. M. T. 14<sup>h</sup> 5<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. N. TRIBBLE.

| Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2 1/2 | 65 2314           | 4584 018              |                        |                     |                              |           | 1 1/2 | 46 8746           | 4383 831              | 871                    | 720                 | 151                          | 10 42     |
| 1     | 64 2565           | 4572 121              |                        |                     |                              |           | 1 1/2 | 46 8483           | 4383 577              |                        |                     |                              |           |
| 2     | 62 4060           | 4549 971              | 639                    | 766                 | 273                          | +18 00    | 1     | 45 6093           | 4371 677              | 707                    | 312                 | 365                          | 27 11     |
| 2     | 62 3706           | 4549 552              |                        |                     |                              |           | 1 1/2 | 45 2419           | 4368 182              | 210                    | 840                 | 370                          | 25 38     |
| 1 1/2 | 60 8339           | 4531 583              | 495                    | 202                 | 293                          | 19 38     | 1     | 46 0709           | 4376 090              |                        |                     |                              |           |
| 1 1/2 | 60 5846           | 4528 704              |                        |                     |                              |           | 1 1/2 | 42 3186           | 4340 924              | 936                    | 634                 | 302                          | 20 85     |
| 2     | 60 1077           | 4523 221              | 307                    | 855                 | 452                          | 29 97     | 1     | 39 4696           | 4315 255              |                        |                     |                              |           |
| 2     | 57 5747           | 4494 670              |                        |                     |                              |           | 1     | 38 6818           | 4308 308              | 296                    | 023                 | 273                          | 18 99     |
| 1     | 53 9251           | 4455 161              | 247                    | 962                 | 285                          | 20 18     | 2     | 37 0702           | 4294 292              |                        |                     |                              |           |
| 1     | 53 5350           | 4451 047              | 131                    | 597                 | 534                          | 35 98     | 2     | 33 0764           | 4260 658              |                        |                     |                              |           |
| 1 1/2 | 54 3107           | 4450 249              |                        |                     |                              |           | 1 1/2 | 28 9385           | 4227 371              | 349                    | 010                 | 339                          | 24 03     |
| 1     | 51 5845           | 4430 779              | 859                    | 678                 | 181                          | 12 25     | 1 1/2 | 25 2344           | 4198 838              | 830                    | 403                 | 427                          | 28 48     |
| 2     | 50 0855           | 4415 538              | 602                    | 293                 | 309                          | 21 09     | 1     | 24 3315           | 4192 055              | 047                    | 678                 | 369                          | +26 37    |
| 1 1/2 | 50 0371           | 4415 051              |                        |                     |                              |           | 2     | 22 9637           | 4181 919              |                        |                     |                              |           |
| 2     | 49 0520           | 4405 195              | 251                    | 951                 | 300                          | 20 42     |       |                   |                       |                        |                     |                              |           |

Weighted mean..... +23 28  
 $V_a$  ..... -23 23  
 $V_d$  ..... 21  
 Curvature..... 28  
 Radial velocity..... - 0 4

η BOÖTIS 372.

1906, Aug. 8,  
G. M. T. 14<sup>h</sup> 15<sup>m</sup>.

Observed by } W. E. HARPER.  
Measured by }

| Wt | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
|    |                   |                       |                        |                     |                              |           |     |                   |                       |                        |                     |                              |           |
| 2  | 72 9730           | 4584 279              |                        |                     |                              |           | 2   | 59 0301           | 4427 683              | 683                    | 420                 | 263                          | 17 80     |
| 1  | 71 4967           | 4566 264              | 114                    | 726                 | 388                          | 25 33     | 3   | 57 8275           | 4415 472              | 456                    | 244                 | 212                          | 14 43     |
| 1  | 71 3535           | 4564 535              |                        |                     |                              |           | 3   | 56 7962           | 4405 149              | 149                    | 951                 | 198                          | 13 48     |
| 2  | 70 6887           | 4556 559              | 530                    | 202                 | 337                          | 22 14     | 3S  | 56 7738           |                       |                        |                     |                              |           |
| 2  | 70 1445           | 4550 683              | 083                    | 766                 | 317                          | 20 85     | 2   | 55 8252           | 4395 551              | 567                    | 286                 | 291                          | 19 84     |
| 2  | 70 1072           |                       |                        |                     |                              |           | 2   | 54 6369           | 4383 963              | 995                    | 720                 | 275                          | 18 81     |
| 2  | 68 9701           | 4536 273              | 233                    | 965                 | 268                          | 17 71     | 1   | 54 6080           | 4383 683              |                        |                     |                              |           |
| 3  | 68 3516           | 4529 077              | 017                    | 807                 | 210                          | 13 90     | 1   | 53 3464           | 4371 570              | 602                    | 312                 | 290                          | 19 89     |
| 3  | 68 3336           | 4528 881              |                        |                     |                              |           | 1   | 53 1912           | 4370 093              | 125                    | 856                 | 269                          | 18 45     |
| 1  | 68 0462           | 4525 563              | 505                    | 295                 | 210                          | 13 95     | 1   | 52 9897           | 4368 180              | 210                    | 840                 | 370                          | 25 38     |
| 2  | 67 8440           | 4523 237              | 177                    | 855                 | 322                          | 21 24     | 2   | 52 1188           | 4359 963              | 979                    | 784                 | 195                          | 13 41     |
| 2  | 65 9487           | 4501 743              | 743                    | 431                 | 312                          | 20 74     | 2   | 52 0196           | 4359 033              | 050                    | 732                 | 318                          | 21 87     |
| 3  | 65 3170           | 4494 693              |                        |                     |                              |           | 2   | 51 2852           | 4352 180              | 180                    | 006                 | 174                          | 11 98     |
| 3  | 64 1450           | 4481 782              | 806                    | 591                 | 215                          | 14 38     | 3   | 48 4145           | 4325 973              |                        |                     |                              |           |
| 2  | 63 6316           | 4476 186              |                        |                     |                              |           | 2   | 47 1450           | 4314 668              | 660                    | 353                 | 307                          | 21 30     |
| 1  | 63 0377           | 4470 518              | 558                    | 300                 | 258                          | 17 28     | 2   | 48 4512           | 4326 302              | 270                    | 939                 | 331                          | 22 93     |
| 2  | 62 7485           | 4466 659              |                        |                     |                              |           | 3S  | 46 3963           |                       |                        |                     |                              |           |
| 2  | 62 7757           | 4466 943              | 983                    | 771                 | 212                          | 14 22     | 2   | 44 8470           | 4294 632              | 552                    | 273                 | 279                          | 19 50     |
| 2  | 62 0833           | 4459 540              | 588                    | 304                 | 284                          | 19 08     | 2   | 44 8210           | 4294 409              |                        |                     |                              |           |
| 1  | 62 0545           | 4459 233              |                        |                     |                              |           | 2   | 44 1405           | 4288 580              | 500                    | 134                 | 366                          | 25 58     |
| 2  | 61 2637           | 4450 865              | 913                    | 596                 | 317                          | 21 33     | 1   | 42 5767           | 4275 360              | 280                    | 922                 | 358                          | 25 09     |
| 2  | 59 7795           | 4435 386              | 406                    | 184                 | 222                          | 15 00     |     |                   |                       |                        |                     |                              |           |

Weighted mean ..... +18 89  
 V<sub>a</sub> ..... - 22 83  
 V<sub>d</sub> ..... - 28  
 Curvature ..... - 50  
 Radial velocity ..... - 4 7

SESSIONAL PAPER No. 25a

$\eta$  BOÖTIS 657.

1907, March 8,  
G. M. T. 18<sup>h</sup> 15<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 70 1436           | 4530 186              | ...                    | ...                 | ...                          | ...       | 1   | 58 8587           | 4425 560              | 385                    | 805                 | 420                          | 28 43     |
| 2   | 70 1197           | 4549 902              | 356                    | 766                 | 410                          | 27 02     | 3   | 57 8397           | 4415 172              | 033                    | 293                 | 260                          | 17 65     |
| 2   | 68 9542           | 4536 160              | 665                    | 965                 | 300                          | 19 86     | 3   | 56 8292           | 4405 001              | ...                    | ...                 | ...                          | ...       |
| 2   | 68 5475           | 4531 415              | 982                    | 202                 | 220                          | 14 58     | 3   | 56 7987           | 4404 697              | 601                    | 951                 | 350                          | 23 83     |
| 2   | 68 4181           | 4529 911              | 489                    | 849                 | 350                          | 23 86     | 2   | 55 8360           | 4395 127              | 056                    | 286                 | 231                          | 16 00     |
| 2   | 68 3585           | 4529 219              | ...                    | ...                 | ...                          | ...       | 2   | 54 6789           | 4383 776              | ...                    | ...                 | ...                          | ...       |
| 2   | 68 3380           | 4528 981              | 557                    | 807                 | 230                          | 16 57     | 2   | 54 6412           | 4383 409              | 370                    | 720                 | 350                          | 23 94     |
| 2   | 67 8226           | 4523 022              | 625                    | 855                 | 230                          | 15 25     | 2   | 53 3717           | 4371 145              | 132                    | 312                 | 160                          | 10 96     |
| 2   | 65 3575           | 4495 078              | ...                    | ...                 | ...                          | ...       | 2   | 53 2120           | 4369 615              | 636                    | 856                 | 220                          | 15 07     |
| 2   | 65 3175           | 4494 631              | 270                    | 550                 | 280                          | 18 67     | 2   | 51 3172           | 4351 693              | 786                    | 006                 | 220                          | 15 14     |
| 2   | 62 8052           | 4467 078              | ...                    | ...                 | ...                          | ...       | 2   | 50 0839           | 4340 245              | 364                    | 634                 | 270                          | 18 63     |
| 2   | 62 6047           | 4461 920              | 562                    | 772                 | 210                          | 14 07     | 3   | 48 4987           | 4325 775              | ...                    | ...                 | ...                          | ...       |
| 2   | 61 6695           | 4454 916              | 642                    | 962                 | 320                          | 21 54     | 3   | 47 9197           | 4320 558              | 752                    | 992                 | 240                          | 16 63     |
| 2   | 61 2555           | 4450 527              | 257                    | 597                 | 340                          | 22 88     | 3   | 46 4945           | 4307 864              | ...                    | ...                 | ...                          | ...       |
| 2   | 59 0292           | 4427 311              | 130                    | 420                 | 290                          | 19 63     | 3   | 46 4645           | 4307 596              | 793                    | 023                 | 230                          | 15 98     |

Weighted mean ..... - 18 92  
 $V_a$  ..... + 13 75  
 $V_d$  ..... + 09  
 Curvature ..... - 50  
 Radial velocity ..... - 5 6

$\eta$  BOÖTIS 670.

1907, March 20,  
G. M. T. 18<sup>h</sup> 32<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 72 9506           | 4583 964              | ...                    | ...                 | ...                          | ...       | 3   | 56 7806           | 4404 929              | ...                    | ...                 | ...                          | ...       |
| 2   | 71 9460           | 4571 690              | 762                    | 112                 | 350                          | 22 92     | 3   | 56 7691           | 4404 724              | 721                    | 951                 | 230                          | 15 68     |
| 2   | 70 0986           | 4549 552              | ...                    | ...                 | ...                          | ...       | 2   | 55 7993           | 4395 209              | ...                    | ...                 | ...                          | ...       |
| 2   | 70 0827           | 4549 365              | 436                    | 766                 | 330                          | 21 74     | 2   | 54 6290           | 4383 769              | ...                    | ...                 | ...                          | ...       |
| 2   | 68 9205           | 4535 721              | 775                    | 965                 | 190                          | 12 58     | 2   | 54 5986           | 4383 548              | 520                    | 720                 | 200                          | 13 68     |
| 2   | 68 5150           | 4531 010              | 062                    | 202                 | 140                          | 9 28      | 2   | 53 1621           | 4369 660              | 626                    | 856                 | 230                          | 15 75     |
| 2   | 68 3215           | 4528 772              | ...                    | ...                 | ...                          | ...       | 2   | 51 2715           | 4351 839              | 796                    | 006                 | 216                          | 14 86     |
| 2   | 68 3066           | 4528 600              | 647                    | 807                 | 160                          | 10 61     | 1   | 50 0474           | 4340 514              | 474                    | 634                 | 150                          | 11 04     |
| 2   | 67 7847           | 4522 500              | 635                    | 855                 | 220                          | 14 60     | 3   | 48 4494           | 4325 976              | ...                    | ...                 | ...                          | ...       |
| 2   | 65 3175           | 4494 740              | ...                    | ...                 | ...                          | ...       | 2   | 48 4195           | 4325 707              | 659                    | 939                 | 280                          | 19 38     |
| 2   | 65 2786           | 4494 308              | 320                    | 550                 | 230                          | 15 31     | 2   | 47 8720           | 4320 790              | 732                    | 992                 | 260                          | 18 00     |
| 2   | 62 7505           | 4466 699              | 651                    | 771                 | 220                          | 14 74     | 3   | 46 4482           | 4308 150              | ...                    | ...                 | ...                          | ...       |
| 2   | 62 7368           | 4466 540              | 592                    | 772                 | 180                          | 12 08     | 3   | 46 4205           | 4307 906              | 843                    | 023                 | 180                          | 12 50     |
| 2   | 62 5583           | 4464 583              | ...                    | ...                 | ...                          | ...       | 1   | 48 2000           | 4271 650              | 570                    | 865                 | 295                          | 20 56     |
| 2   | 61 6272           | 4454 717              | 725                    | 962                 | 237                          | 15 93     | 2   | 40 8897           | 4260 744              | ...                    | ...                 | ...                          | ...       |
| 2   | 58 0902           | 4427 252              | 260                    | 420                 | 160                          | 10 83     | 2   | 40 8547           | 4260 455              | 370                    | 640                 | 270                          | 18 87     |
| 3   | 57 7921           | 4415 071              | 083                    | 293                 | 210                          | 14 26     | ... | ...               | ...                   | ...                    | ...                 | ...                          | ...       |

Weighted mean ..... - 15 25  
 $V_a$  ..... + 8 78  
 $V_d$  ..... + 01  
 Curvature ..... - 50  
 Radial velocity ..... - 6 9

1907. April 3.  
G. M. T. 18<sup>h</sup> 02<sup>m</sup>

7 BOÖTIS 691.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2              | 72 9612           | 4584 946              |                        |                     |                              |           | 3              | 56 7745           | 4404 984              |                        |                     |                              |           |
| 1              | 71 9513           | 4571 717              | 730                    | 900                 | 170                          | -11 13    | 3              | 56 7572           | 4404 812              | 761                    | 951                 | 190                          | 13 62     |
| 1              | 70 6445           | 4556 013              | 922                    | 202                 | 180                          | 11 80     | 2              | 55 7889           | 4395 232              | 176                    | 286                 | 110                          | 7 50      |
| 3              | 70 6995           | 4549 546              | 556                    | 766                 | 210                          | 13 84     | 2              | 54 6189           | 4383 808              |                        |                     |                              |           |
| 2              | 70 1085           | 4549 612              |                        |                     |                              |           | 2              | 54 5876           | 4383 504              | 440                    | 720                 | 280                          | 19 83     |
| 1 <sub>2</sub> | 68 9195           | 4535 705              | 695                    | 965                 | 270                          | 17 87     | 1              | 53 3159           | 4371 275              | 202                    | 312                 | 110                          | 7 55      |
| 1              | 68 5217           | 4531 088              | 072                    | 202                 | 130                          | 8 62      | 1              | 53 1540           | 4369 732              | 666                    | 856                 | 190                          | 13 03     |
| 2              | 68 3245           | 4528 809              |                        |                     |                              |           | 2              | 51 2648           | 4351 942              | 876                    | 006                 | 130                          | 8 96      |
| 2              | 67 7992           | 4522 765              | 735                    | 855                 | 120                          | 7 96      | 1 <sub>2</sub> | 50 0325           | 4340 533              | 489                    | 634                 | 145                          | 10 00     |
| 2              | 65 3230           | 4494 834              |                        |                     |                              |           | 2              | 48 4365           | 4325 995              |                        |                     |                              |           |
| 1              | 65 2775           | 4494 329              | 270                    | 550                 | 280                          | 18 67     | 1              | 47 8566           | 4320 816              | 792                    | 992                 | 200                          | 13 88     |
| 1              | 63 3106           | 4472 793              | 737                    | 957                 | 220                          | 14 76     | 2              | 47 2100           | 4315 086              | 038                    | 178                 | 140                          | 9 73      |
| 2              | 62 7485           | 4466 737              | 612                    | 772                 | 160                          | 10 74     | 3              | 46 4200           | 4308 108              |                        |                     |                              |           |
| 1 <sub>2</sub> | 62 5545           | 4464 657              |                        |                     |                              |           | 2              | 46 4001           | 4307 932              | 883                    | 023                 | 140                          | 9 74      |
| 2              | 62 0287           | 4459 047              | 004                    | 304                 | 300                          | 20 16     | 2              | 40 8496           | 4260 662              |                        |                     |                              |           |
| 1              | 61 6241           | 4454 755              | 712                    | 962                 | 250                          | 16 80     | 2              | 40 8220           | 4260 434              | 420                    | 640                 | 220                          | 15 48     |
| 2              | 61 2216           | 4450 507              | 467                    | 597                 | 130                          | 8 76      | 1              | 37 8036           | 4235 956              | 962                    | 112                 | 150                          | 10 62     |
| 2              | 58 9911           | 4427 357              | 320                    | 420                 | 100                          | 6 77      | 1              | 37 0112           | 4229 664              | 676                    | 826                 | 150                          | -10 65    |
| 1 <sub>2</sub> | 58 8230           | 4425 639              | 605                    | 805                 | 200                          | 13 54     | 1              | 36 7472           | 4227 580              |                        |                     |                              |           |
| 3              | 57 7905           | 4415 163              | 113                    | 293                 | 180                          | 12 22     |                |                   |                       |                        |                     |                              |           |

Weighted mean ..... - 12 29  
 $V_a$  ..... + 12 59  
 $V_d$  ..... 00  
 Curvature ..... 50  
 Radial velocity ..... - 10 2

1907. April 19.  
G. M. T. 18<sup>h</sup> 35<sup>m</sup>

7 BOÖTIS 731.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1 <sub>2</sub> | 72 9712           | 4584 004              |                        |                     |                              |           | 2              | 56 7843           | 4405 001              | 001                    | 951                 | 050                          | + 3 40    |
| 1              | 71 9874           | 4571 996              | 106                    | 116                 | 010                          | + 0 65    | 3              | 56 7769           | 4404 927              |                        |                     |                              |           |
| 2              | 70 1315           | 4549 777              | 776                    | 776                 | 010                          | + 0 66    | 1              | 55 8147           | 4395 409              | 386                    | 286                 | 100                          | + 6 83    |
| 1 <sub>2</sub> | 70 1200           | 4549 641              |                        |                     |                              |           | 2              | 54 6220           | 4383 766              |                        |                     |                              |           |
| 1 <sub>2</sub> | 68 9540           | 4535 965              | 965                    | 965                 | 000                          | 00        | 1 <sub>2</sub> | 54 6211           | 4383 757              | 720                    | 720                 | 000                          | 0 00      |
| 1              | 68 3433           | 4528 888              | 887                    | 807                 | 080                          | + 5 28    | 1 <sub>2</sub> | 53 1719           | 4369 837              | 806                    | 856                 | 050                          | - 3 43    |
| 1              | 68 3355           | 4528 798              |                        |                     |                              |           | 2              | 48 4312           | 4325 956              |                        |                     |                              |           |
| 1              | 63 3442           | 4473 043              | 007                    | 957                 | 050                          | + 3 35    | 1              | 48 4336           | 4325 977              | 959                    | 939                 | 020                          | + 1 38    |
| 1 <sub>2</sub> | 62 7670           | 4466 826              |                        |                     |                              |           | 3              | 46 4205           | 4308 075              |                        |                     |                              |           |
| 1              | 62 5922           | 4464 952              | 902                    | 772                 | 130                          | + 8 74    | 1 <sub>2</sub> | 46 4160           | 4308 036              | 033                    | 023                 | 010                          | + 0 69    |
| 1              | 61 6492           | 4454 916              | 892                    | 962                 | 070                          | - 4 72    | 2              | 40 8494           | 4260 646              |                        |                     |                              |           |
| 1 <sub>2</sub> | 58 8439           | 4425 761              | 755                    | 805                 | 050                          | + 3 38    | 1 <sub>2</sub> | 40 8433           | 4260 595              | 590                    | 640                 | 050                          | - 3 50    |
| 2              | 57 8224           | 4415 399              | 393                    | 293                 | 100                          | + 6 80    |                |                   |                       |                        |                     |                              |           |

Weighted mean ..... + 1 34  
 $V_a$  ..... - 4 57  
 $V_d$  ..... 11  
 Curvature ..... 50  
 Radial velocity ..... - 3 8

SESSIONAL PAPER No. 25a

♄ BOÖTIS 739.

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

1907. April 26.  
G. M. T. 17<sup>h</sup> 30<sup>m</sup>

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 3   | 70 0827           | 4549 755              | 796                    | 766                 | 030                          | - 1 98    | 2   | 57 7755           | 4415 358              | 373                    | 293                 | 080                          | + 5 43    |
| 12  | 70 0699           | 4549 604              | ...                    | ...                 | ...                          | ...       | 3   | 56 7328           | 4404 911              | ...                    | ...                 | ...                          | ...       |
| 12  | 68 9152           | 4536 057              | 105                    | 965                 | 040                          | - 2 65    | 3   | 56 7360           | 4404 943              | 961                    | 951                 | 010                          | + 0 68    |
| 1   | 68 4980           | 4531 213              | 252                    | 202                 | 050                          | + 3 31    | 12  | 55 7610           | 4395 296              | 326                    | 286                 | 046                          | + 2 73    |
| 1   | 68 2387           | 4528 736              | ...                    | ...                 | ...                          | ...       | 12  | 54 5687           | 4383 616              | ...                    | ...                 | ...                          | ...       |
| 1   | 67 7681           | 4522 804              | 815                    | 855                 | 010                          | 0 66      | 12  | 54 5705           | 4383 670              | 750                    | 729                 | 030                          | + 2 05    |
| 1   | 65 8880           | 4501 514              | 548                    | 598                 | 040                          | 2 66      | 1   | 53 1335           | 4369 862              | 926                    | 856                 | 070                          | + 4 80    |
| 1   | 65 2791           | 4494 730              | ...                    | ...                 | ...                          | ...       | 12  | 51 2440           | 4352 066              | 126                    | 006                 | 120                          | + 8 26    |
| 1   | 65 2665           | 4494 590              | 620                    | 550                 | 070                          | + 4 66    | 12  | 50 0165           | 4340 719              | 774                    | 634                 | 140                          | + 9 66    |
| 1   | 63 6012           | 4476 313              | 334                    | 214                 | 120                          | + 8 04    | 12  | 48 3872           | 4325 910              | ...                    | ...                 | ...                          | ...       |
| 12  | 63 5860           | 4476 149              | ...                    | ...                 | ...                          | ...       | 12  | 48 3885           | 4325 922              | 969                    | 939                 | 030                          | + 2 07    |
| 1   | 63 2975           | 4473 023              | 037                    | 967                 | 080                          | + 5 37    | 1   | 47 8422           | 4321 020              | 042                    | 992                 | 050                          | + 3 46    |
| 1   | 62 7133           | 4466 729              | ...                    | ...                 | ...                          | ...       | 3   | 46 3798           | 4308 051              | ...                    | ...                 | ...                          | ...       |
| 1   | 61 6094           | 4454 963              | 972                    | 962                 | 010                          | 0 67      | 12  | 46 3865           | 4308 110              | 133                    | 023                 | 110                          | + 7 63    |
| 12  | 61 2057           | 4450 702              | 707                    | 597                 | 110                          | + 7 41    | 12  | 40 8133           | 4260 641              | ...                    | ...                 | ...                          | ...       |
| 12  | 58 9633           | 4427 425              | 430                    | 420                 | 010                          | + 0 67    | 2   | 40 8102           | 4260 612              | 610                    | 640                 | 031                          | - 2 11    |

Weighted mean ..... + 3 70  
 $V_a$  ..... - 7 58  
 $V_d$  ..... - 99  
 Curvature..... - 50  
 Radial velocity..... - 4 5

♄ BOÖTIS 752.

Observed by W. E. HARPER.

1907. May 7.  
G. M. T. 14<sup>h</sup> 20<sup>m</sup>

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1   | 73 0097           | 4584 071              | ...                    | ...                 | ...                          | ...       | 1   | 61 2811           | 4450 747              | 807                    | 597                 | 210                          | 14 13     |
| 12  | 72 0492           | 4572 350              | 392                    | 112                 | 280                          | + 18 31   | 12  | 59 0410           | 4427 514              | 570                    | 420                 | 150                          | 10 15     |
| 12  | 70 1677           | 4549 830              | 866                    | 776                 | 100                          | 6 60      | 3   | 57 8548           | 4415 473              | 533                    | 293                 | 240                          | 16 30     |
| 1   | 70 1520           | 4549 640              | ...                    | ...                 | ...                          | ...       | 3   | 56 8036           | 4404 951              | 021                    | 951                 | 070                          | 4 77      |
| 1   | 69 0077           | 4536 228              | 286                    | 965                 | 320                          | 21 18     | 3   | 56 7947           | 4404 863              | ...                    | ...                 | ...                          | ...       |
| 12  | 68 5945           | 4531 433              | 492                    | 302                 | 290                          | 19 20     | 3   | 55 8355           | 4395 380              | 456                    | 246                 | 170                          | 11 62     |
| 3   | 68 3596           | 4528 720              | ...                    | ...                 | ...                          | ...       | 12  | 54 6312           | 4383 633              | 720                    | 720                 | 000                          | 00        |
| 1   | 68 3767           | 4528 917              | 987                    | 807                 | 180                          | 11 92     | 12  | 54 6284           | 4383 606              | ...                    | ...                 | ...                          | ...       |
| 12  | 67 8727           | 4523 121              | 195                    | 855                 | 340                          | 22 54     | 12  | 53 2125           | 4370 914              | 116                    | 856                 | 260                          | 17 84     |
| 1   | 65 7679           | 4499 332              | 399                    | 129                 | 270                          | 17 98     | 1   | 51 3040           | 4352 057              | 166                    | 006                 | 160                          | 11 00     |
| 1   | 65 3486           | 4494 672              | ...                    | ...                 | ...                          | ...       | 1   | 50 0865           | 4340 815              | 934                    | 634                 | 300                          | 20 70     |
| 1   | 65 3500           | 4494 679              | 750                    | 550                 | 200                          | 13 34     | 3   | 48 4356           | 4325 827              | ...                    | ...                 | ...                          | ...       |
| 12  | 63 3679           | 4472 994              | 057                    | 967                 | 100                          | 6 70      | 12  | 47 8955           | 4320 987              | 122                    | 992                 | 130                          | 9 00      |
| 1   | 62 7800           | 4466 663              | ...                    | ...                 | ...                          | ...       | 3   | 46 4197           | 4307 917              | ...                    | ...                 | ...                          | ...       |
| 1   | 62 6289           | 4465 038              | 102                    | 772                 | 330                          | 22 11     | 12  | 46 4370           | 4308 068              | 223                    | 023                 | 200                          | + 13 88   |
| 1   | 61 6907           | 4455 067              | 132                    | 962                 | 170                          | 11 44     | 12  | 40 8503           | ...                   | ...                    | ...                 | ...                          | ...       |

Weighted mean ..... + 13 07  
 $V_a$  ..... - 12 01  
 $V_d$  ..... + 11  
 Curvature..... - 50  
 Radial velocity..... + 0 7

$\eta$  BOÖTIS 760.

1907. May 14.  
G. M. T. 17<sup>h</sup> 55<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 77 0138           | 4586 749              | .....                  | .....               | .....                        | .....     | 1½    | 60 3522           | 4476 077              | .....                  | .....               | .....                        | .....     |
| 1½  | 75 0110           | 4572 563              | .....                  | .....               | .....                        | .....     | 1     | 60 3978           | 4476 358              | .....                  | .....               | .....                        | .....     |
| 1   | 74 0961           | 4566 168              | 006                    | 726                 | 280                          | -18 96    | ¾     | 59 8743           | 4473 133              | 223                    | 957                 | 266                          | 17 84     |
| 1   | 72 7052           | 4556 546              | 426                    | 202                 | 224                          | 14 72     | 1½    | 51 9075           | 4425 754              | 924                    | 608                 | 316                          | 21 39     |
| 1   | 71 7539           | 4550 028              | 906                    | 766                 | 149                          | 9 22      | 1     | 48 7471           | 4407 805              | 995                    | 851                 | 144                          | 9 80      |
| 1½  | 71 7146           | 4549 767              | .....                  | .....               | .....                        | .....     | 3     | 48 1928           | 4404 704              | .....                  | .....               | .....                        | .....     |
| 2   | 68 5907           | 4528 772              | .....                  | .....               | .....                        | .....     | 1     | 42 0610           | 4371 304              | 632                    | 312                 | 320                          | 21 95     |
| 1½  | 68 0928           | 4525 481              | 441                    | 295                 | 146                          | 9 66      | 1½    | 38 5042           | 4352 659              | .....                  | .....               | .....                        | .....     |
| 1½  | 67 7272           | 4523 072              | 035                    | 855                 | 180                          | 11 92     | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean ..... +15 25  
 $V_a$  ..... -14 70  
 $V_d$  ..... -14  
 Curvature ..... -50  
 Radial velocity ..... -0 1

$\eta$  BOÖTIS 764.

1907. May 20.  
G. M. T. 16<sup>h</sup> 25<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 76 8697           | 4586 673              | 521                    | 191                 | 330                          | +21 52    | 1   | 57 5027           | 4459 583              | 604                    | 304                 | 300                          | 20 22     |
| 1½  | 76 8647           | 4586 638              | 208                    | 018                 | 190                          | 12 39     | 1   | 56 0698           | 4450 947              | 967                    | 597                 | 370                          | 24 93     |
| 1   | 76 5408           | 4584 329              | 018                    | 618                 | 400                          | 26 08     | 2   | 53 4276           | 4435 427              | 444                    | 184                 | 260                          | 17 57     |
| 1   | 76 2327           | 4582 137              | .....                  | .....               | .....                        | .....     | 2   | 52 0857           | 4427 650              | 666                    | 420                 | 246                          | 16 65     |
| 2   | 76 0296           | 4580 696              | .....                  | .....               | .....                        | .....     | 1½  | 51 8037           | 4426 026              | 038                    | 698                 | 430                          | 29 11     |
| 1   | 73 6806           | 4564 218              | 149                    | 939                 | 210                          | 13 75     | 2½  | 49 9630           | 4415 519              | 523                    | 293                 | 230                          | 15 62     |
| 1½  | 72 5669           | 4556 532              | 472                    | 202                 | 270                          | 17 76     | 2   | 49 9173           | 4415 260              | .....                  | .....               | .....                        | .....     |
| 1   | 72 2842           | 4554 592              | 537                    | 257                 | 280                          | 18 42     | 2   | 48 1222           | 4405 168              | 171                    | 951                 | 220                          | 15 60     |
| 1   | 72 0388           | 4552 913              | 864                    | 504                 | 270                          | 17 76     | 2   | 46 3847           | 4395 539              | 539                    | 286                 | 253                          | 17 25     |
| 2½  | 71 6337           | 4550 080              | 046                    | 766                 | 280                          | 18 42     | 1½  | 44 2712           | 4384 005              | 005                    | 720                 | 285                          | 20 14     |
| 1   | 71 5812           | 4549 791              | .....                  | .....               | .....                        | .....     | 2   | 43 4159           | 4379 392              | .....                  | .....               | .....                        | .....     |
| 1   | 69 5846           | 4536 314              | 295                    | 965                 | 330                          | 21 81     | 1½  | 41 9670           | 4371 648              | 652                    | 312                 | 340                          | 23 30     |
| 2   | 68 4979           | 4529 079              | 077                    | 807                 | 270                          | 17 87     | 2   | 39 7680           | 4360 064              | 074                    | 784                 | 290                          | 19 90     |
| 2   | 67 5999           | 4522 147              | 155                    | 855                 | 300                          | 19 89     | 1½  | 39 5791           | 4359 078              | 086                    | 732                 | 354                          | 24 28     |
| 2   | 65 3760           | 4508 673              | 685                    | 455                 | 230                          | 15 30     | 1   | 38 4112           | 4353 015              | .....                  | .....               | .....                        | .....     |
| 1½  | 64 3050           | 4501 799              | 818                    | 448                 | 370                          | 24 64     | 2   | 38 2760           | 4352 317              | 336                    | 006                 | 330                          | 22 70     |
| 2   | 63 2326           | 4494 979              | 994                    | 664                 | 330                          | 22 01     | 2   | 36 0640           | 4340 994              | 004                    | 634                 | 370                          | 25 53     |
| 1   | 63 1922           | 4494 724              | .....                  | .....               | .....                        | .....     | 2   | 33 0691           | 4325 962              | .....                  | .....               | .....                        | .....     |
| 1½  | 61 1145           | 4481 693              | 710                    | 400                 | 310                          | 20 74     | 1½  | 33 1252           | 4326 247              | 239                    | 939                 | 300                          | 20 76     |
| 2   | 60 2770           | 4476 506              | 524                    | 214                 | 310                          | 20 74     | 2   | 32 1120           | 4321 233              | 226                    | 992                 | 234                          | 16 20     |
| 1½  | 59 7526           | 4473 277              | 297                    | 957                 | 340                          | 22 78     | 1½  | 30 9360           | 4315 473              | 458                    | 178                 | 280                          | 19 40     |
| 1   | 59 1947           | 4469 856              | 876                    | 520                 | 356                          | 23 85     | 2   | 29 4608           | 4308 313              | 293                    | 023                 | 270                          | 18 72     |
| 1   | 58 6782           | 4466 794              | .....                  | .....               | .....                        | .....     | 2   | 29 4193           | 4308 113              | .....                  | .....               | .....                        | .....     |
| 1   | 58 4205           | 4465 137              | 162                    | 772                 | 390                          | 26 13     | 2   | 25 2745           | 4288 450              | 424                    | 134                 | 290                          | 20 27     |

Weighted mean ..... +20 26  
 $V_a$  ..... -16 77  
 $V_d$  ..... -10  
 Curvature ..... -50  
 Radial velocity ..... +2 91

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$\eta$  BOÖTIS 769.

1907, May 22,  
G. M. T. 16<sup>h</sup> 51<sup>m</sup>

Observed by J. S. PEASEKETT,  
Measured by W. E. HALPER.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2               | 72 37.51          | 4554.627              | 507                    | 257                 | 250                          | 16 17     | 2               | 57 58.97          | 4459.591              | 644                    | 304                 | 349                          | 22.91     |
| 1 $\frac{1}{2}$ | 72 14.97          | 4553.084              | 964                    | 594                 | 370                          | 24 38     | 1               | 56 86.22          | 4455.219              | 272                    | 962                 | 310                          | 20.89     |
| 3               | 71 71.56          | 4550.122              | 006                    | 766                 | 240                          | 16 00     | 1 $\frac{1}{2}$ | 52 17.11          | 4427.666              | 729                    | 430                 | 300                          | 20.31     |
| 1 $\frac{1}{2}$ | 71 66.51          | 4549.777              |                        |                     |                              |           | 2               | 50 07.35          | 4415.548              | 598                    | 293                 | 305                          | 20.70     |
| 2               | 68 67.39          | 4536.338              | 255                    | 965                 | 290                          | 19 29     | 2               | 49 59.98          | 4415.214              |                        |                     |                              |           |
| 2               | 68 59.89          | 4529.189              | 107                    | 807                 | 300                          | 19 86     | 1               | 48 20.70          | 4405.161              | 211                    | 951                 | 260                          | 17.73     |
| 2               | 68 54.77          | 4528.841              |                        |                     |                              |           | 2               | 48 15.55          | 4404.877              |                        |                     |                              |           |
| 2               | 67 68.70          | 4523.161              | 105                    | 855                 | 250                          | 16 55     | 3               | 43 49.78          | 4379.372              |                        |                     |                              |           |
| 1               | 66 56.26          | 4515.865              | 768                    | 598                 | 260                          | 17 10     | 1 $\frac{1}{2}$ | 42 05.17          | 4371.654              | 702                    | 312                 | 390                          | 26.75     |
| 1               | 66 49.65          | 4514.789              | 736                    | 476                 | 260                          | 17 26     | 1               | 41 75.60          | 4370.074              | 116                    | 856                 | 260                          | 17.85     |
| 2               | 63 30.54          | 4494.898              | 894                    | 664                 | 230                          | 15 34     | 1               | 41 38.60          | 4368.116              | 160                    | 840                 | 320                          | 21.95     |
| 1 $\frac{1}{2}$ | 63 28.38          | 4494.762              |                        |                     |                              |           | 2               | 38 48.41          | 4352.949              |                        |                     |                              |           |
| 1               | 60 35.30          | 4476.447              | 484                    | 214                 | 270                          | 18 09     | 1 $\frac{1}{2}$ | 38 33.57          | 4352.182              | 246                    | 906                 | 240                          | 16.54     |
| 2               | 59 84.26          | 4473.304              | 337                    | 957                 | 380                          | 25 46     | 1               | 32 19.22          | 4321.209              | 292                    | 992                 | 300                          | 20.76     |
| 1 $\frac{1}{2}$ | 59 27.33          | 4469.814              |                        |                     |                              |           | 2               | 30 98.90          | 4315.312              | 408                    | 178                 | 230                          | +15.92    |
| 2               | 58 48.74          | 4465.924              | 062                    | 772                 | 290                          | 19 48     | 2               | 30 96.43          | 4315.192              |                        |                     |                              |           |

Weighted mean ..... +19.46  
 $V_a$  ..... -17.43  
 $V_d$  ..... 14  
 Curvature ..... 50

Radial velocity ..... + 1.4

$\eta$  BOÖTIS 774.

1907, May 23,  
G. M. T. 14<sup>h</sup> 08<sup>m</sup>

Observed by W. E. HARPER,  
Measured by J. N. TRIBBLE.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1               | 73 37.22          | 4871.911              |                        |                     |                              |           | 1 $\frac{1}{2}$ | 42 57.01          | 4299.750              | 726                    | 277                 | 247                          | 17.23     |
| 2 $\frac{1}{2}$ | 73 53.97          | 4875.973              |                        |                     |                              |           | 1 $\frac{1}{2}$ | 40 64.25          | 4272.077              | 053                    | 760                 | 293                          | 20.56     |
| 1 $\frac{1}{2}$ | 72 94.89          | 4861.911              | 803                    | 527                 | 276                          | +17.03    | 1 $\frac{1}{2}$ | 40 42.52          | 4269.004              |                        |                     |                              |           |
| 2               | 56 7.439          | 4528.932              |                        |                     |                              |           | 2               | 39 83.99          | 4260.771              | 747                    | 640                 | 107                          | 7.53      |
| 1               | 57 99.13          | 4549.900              |                        |                     |                              |           | 2               | 36 58.92          | 4216.114              | 102                    | 897                 | 105                          | 7.47      |
| 1               | 57 92.93          | 4550.311              | 119                    | 766                 | 353                          | 23 36     | 2 $\frac{1}{2}$ | 36 15.74          | 4210.469              |                        |                     |                              |           |
| 1               | 52 53.04          | 4435.601              | 565                    | 962                 | 603                          | 40 65     | 1 $\frac{1}{2}$ | 35 57.47          | 4202.733              | 733                    | 161                 | 272                          | 17.51     |
| 2 $\frac{1}{2}$ | 48 85.21          | 4395.386              |                        |                     |                              |           | 1               | 35 29.17          | 4198.999              | 999                    | 494                 | 505                          | 36.07     |
| 2 $\frac{1}{2}$ | 49 17.26          | 4400.502              |                        |                     |                              |           | 1 $\frac{1}{2}$ | 33 53.45          | 4202.202              |                        |                     |                              |           |
| 1               | 49 45.86          | 4405.990              | 982                    | 908                 | 074                          | 5 04      | 1               | 30 08.03          | 4132.687              | 767                    | 212                 | 555                          | 40.29     |
| 1               | 49 21.38          | 4401.162              | 162                    | 138                 | 424                          | 28 87     | 1               | 29 34.27          | 4123.660              |                        |                     |                              |           |
| 1 $\frac{1}{2}$ | 45 36.18          | 4341.187              |                        |                     |                              |           | 1               | 28 97.02          | 4119.134              | 234                    | 844                 | 396                          | 28.38     |
| 1               | 45 34.71          | 4340.964              | 948                    | 634                 | 314                          | 21 82     | 1               | 27 55.32          | 4102.111              | 218                    | 000                 | 218                          | 15.94     |
| 1               | 43 13.30          | 4307.974              | 950                    | 932                 | 018                          | 1 25      | 2               | 26 78.17          | 4092.974              | 078                    | 626                 | 452                          | 33.13     |
| 2               | 42 55.31          | 4299.593              |                        |                     |                              |           |                 |                   |                       |                        |                     |                              |           |

Weighted mean ..... +21.29  
 $V_a$  ..... -17.73  
 $V_d$  ..... 03  
 Curvature ..... 28

Radial velocity ..... + 3.2

1907. May 24.  
G. M. T. 15<sup>h</sup> 01<sup>m</sup>

$\eta$  BOÖTIS 779.

Observed by J. S. PLASKETT.  
Measured by J. N. TRIBBLE.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2               | 58 0640           | 4549 549              |                        |                     |                              |           | 1 $\frac{1}{2}$ | 40 8102           | 4271 728              | 872                    | 760                 | 112                          | 7 85      |
| 1               | 58 0817           | 4549 873              | 001                    | 766                 | 235                          | +15 46    | 2               | 37 6159           | 4227 429              |                        |                     |                              |           |
| 2               | 50 2577           | 4415 039              |                        |                     |                              |           | 1 $\frac{1}{2}$ | 37 5998           | 4227 211              | 331                    | 904                 | 427                          | 30 27     |
| 1               | 50 2836           | 4415 459              | 595                    | 293                 | 302                          | 20 54     | 1               | 36 7625           | 4215 917              | 021                    | 897                 | 124                          | 8 82      |
| 2 $\frac{1}{2}$ | 49 6247           | 4404 812              |                        |                     |                              |           | 1               | 35 4747           | 4198 795              | 907                    | 403                 | 505                          | 35 99     |
| 1               | 49 6384           | 4405 032              | 216                    | 951                 | 265                          | 18 05     | 1               | 33 0716           | 4167 618              | 706                    | 438                 | 268                          | 19 27     |
| 1 $\frac{1}{2}$ | 46 3206           | 4352 943              |                        |                     |                              |           | 2               | 31 1734           | 4143 682              |                        |                     |                              |           |
| 1               | 46 2767           | 4352 270              | 454                    | 006                 | 445                          | 30 86     | 1               | 31 1972           | 4143 979              | 051                    | 914                 | 137                          | 9 91      |
| 1               | 45 5212           | 4340 743              | 939                    | 634                 | 305                          | 20 95     | 1               | 29 9036           | 4127 997              | 053                    | 862                 | 191                          | +13 88    |
| 2 $\frac{1}{2}$ | 40 8015           | 4271 605              |                        |                     |                              |           | 2               | 28 0030           | 4104 992              |                        |                     |                              |           |

Weighted mean ..... - 18 15  
 $V_a$  ..... - 18 04  
 $V_d$  ..... - 21  
 Curvature ..... - 28  
 Radial velocity ..... - 0 3

1907. May 29.  
G. M. T. 16<sup>h</sup> 46<sup>m</sup>

$\eta$  BOÖTIS 793.

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1               | 61 2207           | 4613 852              |                        |                     |                              |           | 2               | 47 7600           | 4379 416              |                        |                     |                              |           |
| 1 $\frac{1}{2}$ | 61 2151           | 4613 629              | 755                    | 465                 | 290                          | -18 76    | 1 $\frac{1}{2}$ | 47 9501           | 4368 323              | 307                    | 840                 | 467                          | 32 04     |
| 1               | 60 7801           | 4605 266              | 437                    | 997                 | 440                          | 28 51     | 1               | 45 2664           | 4340 948              | 954                    | 634                 | 320                          | 22 08     |
| 1               | 60 5522           | 4606 908              | 076                    | 524                 | 552                          | 35 76     | 2               | 44 2835           | 4326 157              | 174                    | 694                 | 480                          | 33 22     |
| 1               | 59 7843           | 4586 340              |                        |                     |                              |           | 1               | 43 0857           | 4308 409              | 443                    | 023                 | 420                          | 29 15     |
| 1               | 59 6576           | 4583 954              | 150                    | 796                 | 354                          | 23 08     | 2               | 43 0609           | 4308 044              |                        |                     |                              |           |
| 1               | 57 8364           | 4550 173              | 308                    | 766                 | 542                          | 35 72     | 1 $\frac{1}{2}$ | 40 5687           | 4272 055              | 090                    | 760                 | 330                          | 23 20     |
| 1               | 56 6522           | 4528 720              |                        |                     |                              |           | 1               | 39 7598           | 4260 611              |                        |                     |                              |           |
| 1               | 52 7172           | 4460 183              |                        |                     |                              |           | 2               | 39 7727           | 4260 835              | 861                    | 546                 | 315                          | 22 14     |
| 1               | 50 0340           | 4415 682              | 783                    | 293                 | 490                          | 33 37     | 1               | 37 8163           | 4233 751              | 768                    | 328                 | 440                          | 31 15     |
| 1               | 49 3967           | 4405 432              | 471                    | 951                 | 520                          | 35 46     | 1 $\frac{1}{2}$ | 36 5183           | 4216 158              | 167                    | 897                 | 270                          | +19 17    |
| 1               | 48 7702           | 4395 400              |                        |                     |                              |           | 2               | 35 4705           | 4202 202              |                        |                     |                              |           |
| 2               | 48 8021           | 4395 999              | 896                    | 286                 | 610                          | 41 66     |                 |                   |                       |                        |                     |                              |           |

Weighted mean ..... + 29 03  
 $V_a$  ..... - 19 56  
 $V_d$  ..... - 15  
 Curvature ..... - 50  
 Radial velocity ..... + 8 8



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γ BOÖTIS 797.

1907. May 31.  
G. M. T. 14<sup>h</sup> 54<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72·9660           |                          |                              |           | 2   | 43·0819           | 0711                     | 0208                         | 21·20     |
| 2   | 72·8399           | 8829                     | 0181                         | +26·26    | 2   | 40·5728           | 5560                     | 0301                         | 29·86     |
| 2   | 72·4047           |                          |                              |           | 2   | 39·7707           | 7517                     | 0249                         | 24·50     |
| 2   | 57·8365           | 8410                     | 0142                         | 17·10     | 2   | 39·7551           |                          |                              |           |
| 2   | 57·8055           |                          |                              |           | 1½  | 37·3501           | 3227                     | 0339                         | 32·51     |
| 2   | 50·0029           |                          |                              |           | 2   | 36·5196           | 4893                     | 0271                         | 25·77     |
| 1½  | 49·3909           | 3937                     | 0263                         | 28·72     | 1½  | 35·4969           | 4631                     | 0355                         | 33·40     |
| 1   | 48·7877           | 7855                     | 0215                         | 23·53     | 2   | 35·4641           |                          |                              |           |
| 2   | 48·7722           |                          |                              |           | 1½  | 31·6032           | 5560                     | 0151                         | 13·65     |
| 1   | 47·0514           | 0483                     | 0352                         | 37·45     | 2   | 30·1736           |                          |                              |           |
| 2   | 45·2777           |                          |                              |           | 2   | 27·3086           |                          |                              |           |
| 1½  | 45·2658           | 2617                     | 0230                         | 23·56     | 1½  | 26·7220           | 6579                     | 0296                         | +25·48    |
| 2   | 43·5481           |                          |                              |           | 2   | 26·7084           |                          |                              |           |

Weighted mean ..... -25·50  
 V<sub>a</sub> ..... -20·10  
 V<sub>d</sub> ..... -05  
 Curvature ..... -28  
 Radial velocity ..... +5·1

γ BOÖTIS 812.

1907. June 10.  
G. M. T. 14<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|---------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|---------------|-----------|
| 2   | 72·8854           | 4864·874              |                        |                     |               |           | 2   | 43·0742           | 4308·544              | 560                    | 023                 | 537           | 37·37     |
| 2   | 72·7643           | 4862·010              | 047                    | 527                 | 520           | +32·08    | 2   | 42·0980           | 4294·278              |                        |                     |               |           |
| 1½  | 57·8020           | 4550·549              | 386                    | 766                 | 620           | 40·85     | 1   | 41·3355           | 4283·269              | 285                    | 722                 | 563           | 39·00     |
| 2   | 57·7617           | 4549·811              |                        |                     |               |           | 2   | 40·5595           | 4272·188              | 204                    | 760                 | 444           | 31·12     |
| 2   | 53·0646           | 4466·768              |                        |                     |               |           | 1½  | 39·7632           | 4260·968              | 987                    | 527                 | 460           | 32·34     |
| 1½  | 52·9887           | 4465·474              | 412                    | 772                 | 640           | 42·94     | 2   | 39·7401           | 4260·615              |                        |                     |               |           |
| 2   | 52·4971           | 4455·617              | 562                    | 962                 | 600           | 40·32     | 2   | 39·0561           | 4251·055              | 067                    | 643                 | 424           | 29·89     |
| 2   | 52·2073           | 4452·249              |                        |                     |               |           | 1½  | 37·8028           | 4233·770              | 778                    | 462                 | 316           | 22·37     |
| 2   | 49·3623           | 4405·394              | 391                    | 908                 | 483           | 32·84     | 2   | 37·3322           | 4227·356              | 364                    | 010                 | 354           | 25·06     |
| 2   | 48·7661           | 4395·825              | 826                    | 426                 | 400           | 27·28     | 1½  | 35·2093           | 4198·927              | 924                    | 494                 | 430           | 30·70     |
| 2   | 45·9963           | 4352·404              | 412                    | 957                 | 455           | 31·44     | 2   | 34·6878           | 4192·067              | 068                    | 678                 | 390           | 27·70     |
| 2   | 45·2575           | 4341·177              |                        |                     |               |           | 2   | 31·9631           | 4156·989              | 989                    | 623                 | 366           | 26·35     |
| 2   | 45·2518           | 4341·089              | 099                    | 634                 | 465           | 32·08     | 2   | 30·9498           | 4144·262              | 262                    | 928                 | 334           | +24·11    |
| 1½  | 44·2637           | 4326·286              | 299                    | 939                 | 360           | 24·91     | 2   | 27·3112           | 4099·919              |                        |                     |               |           |

Weighted mean ..... +30·09  
 V<sub>a</sub> ..... -22·52  
 V<sub>d</sub> ..... -04  
 Curvature ..... -28  
 Radial velocity ..... +7·2

$\eta$  BOÖTIS 868.

1907, June 21,  
G. M. T. 14<sup>h</sup> 27

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|---------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|---------------|-----------|
| 3   | 59 4917           | 4580 498              |                        |                     |               |           | 12  | 45 2755           | 4341 984              |                        |                     |               |           |
| 3   | 59 0511           | 4572 262              | 308                    | 758                 | 550           | -35 91    | 12  | 44 2785           | 4326 119              | 199                    | 939                 | 260           | 18 00     |
| 3   | 57 8496           | 4550 091              | 156                    | 766                 | 390           | 25 70     | 2   | 43 5520           | 4315 347              | 448                    | 178                 | 270           | 18 71     |
| 13  | 57 8233           | 4549 613              |                        |                     |               |           | 2   | 42 1004           | 4294 152              |                        |                     |               |           |
| 3   | 56 6631           | 4528 612              |                        |                     |               |           | 1   | 40 5592           | 4272 120              | 270                    | 760                 | 510           | 35 70     |
| 11  | 56 3594           | 4523 178              | 345                    | 985                 | 360           | 23 80     | 3   | 39 7555           | 4260 816              | 947                    | 527                 | 420           | 29 53     |
| 13  | 53 1004           | 4466 545              |                        |                     |               |           | 12  | 39 7351           | 4260 530              |                        |                     |               |           |
| 12  | 50 9767           | 4430 966              | 138                    | 678                 | 460           | 31 14     | 1   | 36 4997           | 4216 283              | 323                    | 897                 | 426           | 30 12     |
| 12  | 50 0392           | 4415 661              | 824                    | 354                 | 470           | 31 96     | 11  | 35 4821           | 4202 764              | 768                    | 198                 | 570           | 40 58     |
| 12  | 50 0050           | 4415 107              |                        |                     |               |           | 2   | 35 4386           | 4202 190              |                        |                     |               |           |
| 12  | 49 4000           | 4405 349              | 498                    | 908                 | 590           | 40 18     | 1   | 34 6655           | 4192 948              | 088                    | 678                 | 360           | 25 74     |
| 12  | 48 7697           | 4395 275              |                        |                     |               |           | 1   | 32 7961           | 4167 952              | 902                    | 617                 | 285           | 20 49     |
| 2   | 47 2771           | 4371 789              | 893                    | 343                 | 550           | 37 62     | 2   | 30 1393           | 4134 712              |                        |                     |               |           |
| 11  | 47 1802           | 4370 281              | 887                    | 867                 | 520           | 35 56     | 1   | 29 9750           | 4132 694              | 592                    | 212                 | 380           | 27 40     |

Weighted mean..... -29 89  
 $V_a$ ..... -24 46  
 $V_d$ ..... 11  
 Curvature..... 28

Radial velocity..... - 5 0

$\eta$  BOÖTIS 891.

1907, June 27,  
G. M. T. 14<sup>h</sup> 55<sup>m</sup>

Observed by W. E. HARPER,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 7980           | 8200                     | 0173                         | 29 87     | 2   | 40 5817           | 5833                     | 0324                         | 32 24     |
| 1   | 57 7762           |                          |                              |           | 2   | 39 7320           | 7845                     | 0300                         | 29 61     |
| 2   | 49 9624           |                          |                              |           | 2   | 39 7102           |                          |                              |           |
| 1   | 49 3500           | 3936                     | 0279                         | 30 55     | 1   | 37 3052           | 3613                     | 0363                         | 35 57     |
| 2   | 48 7547           | 7987                     | 0160                         | 17 41     | 1   | 36 4711           | 5275                     | 0262                         | 25 41     |
| 2   | 48 7277           |                          |                              |           | 1   | 35 1539           | 5119                     | 0414                         | 39 54     |
| 11  | 47 0142           | 0602                     | 0391                         | 41 25     | 2   | 35 4170           |                          |                              |           |
| 2   | 45 2395           |                          |                              |           | 1   | 31 5636           | 6300                     | 0313                         | 28 17     |
| 11  | 45 2339           | 2809                     | 0322                         | 33 71     | 2   | 30 1178           |                          |                              |           |
| 2   | 43 5028           |                          |                              |           | 2   | 27 2449           |                          |                              |           |
| 2   | 43 0515           | 1009                     | 0377                         | 38 52     | 11  | 26 6595           | 7335                     | 0272                         | 24 12     |
| 2   | 42 0723           |                          |                              |           | 2   | 26 6400           |                          |                              |           |

Weighted mean..... +30 53  
 $V_a$ ..... -24 37  
 $V_d$ ..... 17  
 Curvature..... 28

Radial velocity..... + 5 7

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$\eta$  BOÖTIS 918.

1907, July 8,  
G. M. T. 15<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59 8099           |                          |                              |           | 1   | 44 2898           | 2798                     | 0206                         | 21 27     |
| 1   | 57 8572           | 8620                     | 0352                         | -42 38    | 1   | 43 5460           |                          |                              |           |
| 1   | 56 6611           |                          |                              |           | 1   | 43 0888           | 0758                     | 0255                         | 25 98     |
| 1   | 55 1526           | 1576                     | 0324                         | 37 77     | 1   | 41 3060           |                          |                              |           |
| 1½  | 54 7393           |                          |                              |           | 1   | 40 5805           | 5615                     | 0356                         | 35 31     |
| 1   | 50 0034           |                          |                              |           | 1   | 39 7823           | 7613                     | 0264                         | 25 97     |
| 1   | 50 0306           | 6296                     | 0205                         | 22 55     | 1   | 37 9860           |                          |                              |           |
| 1   | 49 4064           | 4034                     | 0360                         | 39 31     | 1   | 37 3568           | 3308                     | 0480                         | 46 04     |
| 1   | 49 1127           |                          |                              |           | 1½  | 36 5317           | 5047                     | 0425                         | 49 41     |
| 1   | 48 8040           | 8020                     | 0292                         | 31 68     | 1   | 35 4581           |                          |                              |           |
| 1½  | 48 7675           |                          |                              |           | 1   | 35 2228           | 1928                     | 0438                         | 41 08     |
| 1   | 46 0327           | 0257                     | 0385                         | 40 40     | 1   | 31 8048           | 7713                     | 0232                         | +21 01    |
| 1   | 45 2824           | 2744                     | 0437                         | 45 62     | 1   | 30 9164           |                          |                              |           |
| 1   | 45 2825           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... + 34 45  
 $V_a$  ..... - 25 79  
 $V_d$  ..... - 24  
 Curvature ..... - 28

Radial velocity ..... + 8 1

$\eta$  BOÖTIS 918.\*

1907, July 8,  
G. M. T. 15<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1½  | 59 0510           |                          |                              |           | 2   | 44 3211           | 2820                     | 0228                         | 23 55     |
| 1   | 59 0584           | 0634                     | 0227                         | -27 74    | 2   | 43 5749           |                          |                              |           |
| 2   | 57 8689           | 8520                     | 0252                         | 30 34     | 2   | 43 1211           | 0790                     | 0327                         | 33 32     |
| 2   | 57 8388           |                          |                              |           | 2   | 41 8827           | 8380                     |                              |           |
| 1   | 56 8542           | 8352                     | 0244                         | 29 04     | 2   | 41 3385           |                          |                              |           |
| 2   | 56 6862           |                          |                              |           | 2   | 40 6093           | 5590                     | 0331                         | 32 83     |
| 1   | 55 1704           | 1464                     | 0212                         | 24 72     | 2   | 39 8204           | 1694                     | 0345                         | 33 95     |
| 2   | 54 0562           |                          |                              |           | 1½  | 39 7879           |                          |                              |           |
| 1½  | 52 8790           | 8510                     | 0206                         | 23 40     | 2   | 39 1058           | 0523                     | 0370                         | 36 11     |
| 2   | 52 4827           | 4547                     | 0399                         | 45 13     | 2   | 38 0112           |                          |                              |           |
| 2   | 52 2770           |                          |                              |           | 2   | 37 3845           | 3295                     | 0407                         | 39 03     |
| 2   | 50 0586           | 0280                     | 0179                         | 19 69     | 2   | 36 5511           | 4940                     | 0318                         | 30 24     |
| 2   | 49 4332           | 4012                     | 0350                         | 38 22     | 2   | 35 4884           |                          |                              |           |
| 2   | 48 8006           |                          |                              |           | 1   | 35 5290           | 4706                     | 0430                         | 40 46     |
| 2   | 45 3140           |                          |                              |           | 1½  | 35 2561           | 1973                     | 0483                         | +45 06    |
| 2   | 45 3180           | 2800                     | 0413                         | 43 12     |     |                   |                          |                              |           |

Weighted mean ..... + 33 11  
 $V_a$  ..... - 25 80  
 $V_d$  ..... - 24  
 Curvature ..... - 28

Radial velocity ..... + 6 8

\*Check measurement.

1907, July 18,  
G. M. T. 13<sup>h</sup> 57<sup>m</sup>

$\eta$  BOÖTIS 950.

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 59.7949           |                          |                              |           | 1 $\frac{1}{2}$ | 43.5484           | .5524                    | .0192                        | 19.68     |
| 1               | 59.0352           | .0672                    | .0265                        | -32.36    | 2               | 43.0820           | .0852                    | .0451                        | 45.95     |
| 1 $\frac{1}{2}$ | 57.8347           | .8427                    | .0160                        | 19.26     | 1 $\frac{1}{2}$ | 42.1019           |                          |                              |           |
| 2               | 53.0966           |                          |                              |           | 2               | 40.5663           | .5655                    | .0396                        | 39.28     |
| 1 $\frac{1}{2}$ | 52.8357           | .8490                    | .0186                        | 21.13     | 2               | 39.7395           |                          |                              |           |
| 2               | 52.4416           | .4546                    | .0398                        | 45.01     | 1               | 39.7719           | .7700                    | .0351                        | 34.54     |
| 1 $\frac{1}{2}$ | 50.0253           | .0343                    | .0241                        | 26.51     | 1               | 39.0430           | .0385                    | .0222                        | 21.67     |
| 1               | 49.3917           | .3997                    | .0331                        | 36.14     | 2               | 37.9630           |                          |                              |           |
| 1 $\frac{1}{2}$ | 48.7944           | .8010                    | .0282                        | 30.79     | 1               | 37.3251           | .3195                    | .0307                        | 29.44     |
| 2               | 48.7650           |                          |                              |           | 1               | 36.5090           | .5020                    | .0398                        | 37.85     |
| 2               | 45.2671           |                          |                              |           | 3               | 35.4418           |                          |                              |           |
| $\frac{1}{2}$   | 45.2590           | .2654                    | .0267                        | 27.87     | 1               | 35.4710           | .4595                    | .0319                        | 30.02     |
|                 |                   |                          |                              |           | 1               | 35.1990           | .1875                    | .0385                        | +35.92    |

Weighted mean ..... -31.38  
 $V_a$  ..... -25.61  
 $V_d$  ..... -20  
 Curvature ..... -28

Radial velocity..... -5.3

1907, July 18,  
G. M. T. 13<sup>h</sup> 57<sup>m</sup>

$\eta$  BOÖTIS 950.\*

Observed by J. N. TRIBBLE.  
Measured by T. H. PARKER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1               | 59.8053           |                          |                              |           | 1               | 43.0955           | .0835                    | .0332                        | 33.82     |
| 1               | 59.0690           | .0730                    | .0323                        | +39.43    | 1               | 42.1179           |                          |                              |           |
| 1               | 57.8528           | .8563                    | .0295                        | 35.51     | 1 $\frac{1}{2}$ | 40.5776           | .5621                    | .0362                        | 35.91     |
| 1               | 57.0777           | .0807                    | .0139                        | 16.58     | 1               | 39.7823           | .7653                    | .0304                        | 29.91     |
| 1 $\frac{1}{2}$ | 56.6654           |                          |                              |           | 1               | 38.0089           | .9889                    | .0278                        | 26.93     |
| 1               | 53.1105           |                          |                              |           | 1               | 37.9769           |                          |                              |           |
| 1               | 52.8502           | .8512                    | .0208                        | 23.62     | 1               | 37.8012           | .7822                    | .0177                        | 17.06     |
| 1               | 52.4460           | .4470                    | .0322                        | 36.41     | 1               | 36.5180           | .4960                    | .0338                        | 32.04     |
| 1               | 45.2830           |                          |                              |           | 1               | 35.4775           | .4535                    | .0259                        | +24.37    |
| 1               | 43.5729           | .5619                    | .0287                        | 29.43     | 1               | 35.4548           |                          |                              |           |

Weighted mean..... +29.23  
 $V_a$  ..... -25.61  
 $V_d$  ..... -20  
 Curvature ..... -28

Radial velocity..... +3.1

\*Check measurement.

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$\eta$  BOÖTIS 372

1907. Aug. 1  
G. M. T. 13<sup>h</sup> 39<sup>m</sup>

Observed by W. E. HARPER.  
Measured by

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 59.8125           |                          |                              |           | 1               | 47.2717           | 2733                     | 0315                         | 33.55     |
| 1               | 59.0699           | 0660                     | 0253                         | +30.89    | 1               | 47.1677           | 1693                     | 0225                         | 23.96     |
| 2               | 57.8529           | 8497                     | 0229                         | 27.57     | 1               | 47.0555           | 0571                     | 0409                         | 43.56     |
| 2               | 57.8249           |                          |                              |           | 2               | 45.2721           |                          |                              |           |
| 2               | 56.6666           |                          |                              |           | 1 $\frac{1}{2}$ | 45.2731           | 2751                     | 0364                         | 38.00     |
| 1               | 56.3701           | 3709                     | 0347                         | 41.05     | 2               | 43.5334           |                          |                              |           |
| 1               | 55.1626           | 1612                     | 0390                         | 45.47     | 1               | 43.0770           | 0795                     | 0332                         | 33.90     |
| 2               | 54.0291           |                          |                              |           | 2               | 40.5588           | 5580                     | 0321                         | 31.84     |
| 1 $\frac{1}{2}$ | 52.8504           | 8494                     | 0190                         | 21.58     | 1 $\frac{1}{2}$ | 39.7640           | 7620                     | 0352                         | 34.64     |
| 1               | 52.4609           | 4600                     | 0452                         | 51.12     | 2               | 39.7388           |                          |                              |           |
| 2               | 52.2516           |                          |                              |           | 2               | 37.9622           |                          |                              |           |
| 1               | 50.0488           | 0488                     | 0387                         | 42.57     | 2               | 37.3332           | 3284                     | 0396                         | 37.97     |
| 1 $\frac{1}{2}$ | 49.4090           | 4048                     | 0386                         | 42.57     | 2               | 36.5021           | 4960                     | 0338                         | +32.14    |
| 2               | 48.7681           |                          |                              |           | 2               | 35.4344           |                          |                              |           |

Weighted mean ..... - 36.02  
 $V_a$  ..... - 24.14  
 $V_z$  ..... - .24  
 Curvature ..... - .28

Radial velocity ..... + 11.4

$\eta$  BOÖTIS 390.

1907. Aug. 7.  
G. M. T. 13<sup>h</sup> 58<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1               | 77.5311           | 3820                     | 0765                         | +34.73    | 2               | 68.8751           |                          |                              |           |
| 2               | 77.5065           |                          |                              |           | 1 $\frac{1}{2}$ | 68.0457           | 9537                     | 0875                         | 37.45     |
| 1               | 77.2249           | 0775                     | 0838                         | 37.88     | 2               | 67.6516           | 5636                     | 0768                         | 32.87     |
| 1 $\frac{1}{2}$ | 75.4840           | 3450                     | 0687                         | 30.91     | 2               | 64.6597           | 5717                     | 0641                         | 26.92     |
| 2               | 75.3861           |                          |                              |           | 2               | 61.4950           |                          |                              |           |
| 1 $\frac{1}{2}$ | 74.5148           | 4108                     | 0755                         | 33.75     | 1 $\frac{1}{2}$ | 60.5500           | 5045                     | 0777                         | 31.62     |
| 2               | 73.1143           | 9873                     | 0597                         | 26.45     | 2               | 58.9771           | 9411                     | 0833                         | 33.57     |
| 2               | 72.8337           | 7101                     | 0719                         | 31.71     | 1               | 58.6538           | 6200                     | 0878                         | 35.38     |
| 3               | 72.1565           | 0350                     | 0677                         | 29.79     | 2               | 56.4377           |                          |                              |           |
| 2               | 72.0721           |                          |                              |           | 1               | 50.0635           | 0820                     | 0726                         | 27.66     |
| 2               | 70.0758           | 9700                     | 0879                         | 38.15     | 1 $\frac{1}{2}$ | 48.1930           | 2266                     | 0853                         | +32.07    |
| 2               | 69.3246           | 2233                     | 0691                         | 27.78     | 2               | 46.3541           |                          |                              |           |
| 2               | 68.9702           | 8732                     | 0867                         | 37.37     |                 |                   |                          |                              |           |

Weighted mean ..... + 32.66  
 $V_a$  ..... - 23.09  
 $V_z$  ..... - .28  
 Curvature ..... - .28

Radial velocity ..... - 9.0

9-10 EDWARD VII., A. 1910

 $\eta$  BOÖTIS 1231.1908, Jan. 14.  
G. M. T. 22<sup>h</sup> 10<sup>m</sup>Observed by W. E. HARPER.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1               | 57 8434           |                          |                              |           | 1½  | 44 2401           | 2266                     | 0326                         | 33.67     |
| 2               | 57 8277           | 8047                     | 0221                         | -26.61    | 2   | 41 3012           |                          |                              |           |
| 1½              | 54 7947           |                          |                              |           | 2   | 40 5147           | 5000                     | 0259                         | 25.69     |
| 2               | 53 1290           |                          |                              |           | 2   | 39 7496           |                          |                              |           |
| 1               | 52 8248           | 8048                     | 0256                         | 29.08     | 2   | 39 7099           | 6959                     | 0309                         | 30.40     |
| 2               | 52 3986           | 3790                     | 0358                         | 40.49     | 1½  | 39 0059           | 9925                     | 0238                         | 23.23     |
| 2               | 52 2705           |                          |                              |           | 2   | 37 9716           |                          |                              |           |
| 2               | 49 9963           | 9788                     | 0313                         | 34.43     | 2   | 37 2765           | 2630                     | 0258                         | 24.74     |
| 1½              | 49 3502           | 3310                     | 0334                         | 36.47     | 1½  | 36 4496           | 4350                     | 0272                         | 25.87     |
| 2               | 48 7851           |                          |                              |           | 2   | 35 4474           |                          |                              |           |
| 1½              | 48 7630           | 7470                     | 0258                         | 28.00     | 1½  | 35 4212           | 4043                     | 0233                         | 21.92     |
| 2               | 45 2867           |                          |                              |           | 1½  | 35 1325           | 1150                     | 0340                         | -31.72    |
| 1½              | 45 2195           | 2060                     | 0327                         | 34.14     |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | -29.76    |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | +26.58    |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | +12       |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | -28       |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | -3.3      |

 $\eta$  BOÖTIS 1231.\*1908, Jan. 14.  
G. M. T. 22<sup>h</sup> 00<sup>m</sup>Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2               | 59 8174           |                          |                              |           | 1   | 44 2321           |                          |                              |           |
| 1               | 57 8144           | 8084                     | 0182                         | -21.91    | 1   | 41 2816           |                          |                              |           |
| 1               | 56 6735           |                          |                              |           | 1   | 40 4982           | 5032                     | 0227                         | 22.51     |
| 1               | 53 1182           |                          |                              |           | 1   | 39 7312           |                          |                              |           |
| 1               | 52 8153           | 8133                     | 0171                         | 19.42     | 2   | 39 6870           | 6915                     | 0353                         | 34.73     |
| 1½              | 52 3882           | 3872                     | 0276                         | 31.21     | 1½  | 37 9558           |                          |                              |           |
| 2               | 52 2605           |                          |                              |           | 1   | 37 2517           | 2567                     | 0321                         | 33.66     |
| 1               | 50 0076           |                          |                              |           | 1   | 36 4308           | 4358                     | 0264                         | 25.00     |
| 2               | 49 9827           | 9847                     | 0254                         | 27.94     | 2   | 35 4251           |                          |                              |           |
| 1               | 49 3633           |                          |                              |           | 1   | 35 3991           | 4041                     | 0264                         | 24.84     |
| 1               | 49 3360           | 3390                     | 0272                         | 29.70     | 1   | 30 8692           |                          |                              |           |
| 1               | 49 1928           |                          |                              |           | 1   | 30 8499           | 8543                     | 0213                         | -19.12    |
| 1               | 48 7675           |                          |                              |           | 1   | 29 9064           |                          |                              |           |
| 1               | 48 7445           | 7485                     | 0155                         | 16.81     |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | -25.62    |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | +26.58    |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | +12       |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | -28       |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | +0.6      |

\*Check measurement.

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$\eta$  BOÖTIS 1291.

1908, Jan. 27,  
G. M. T. 20<sup>h</sup> 12<sup>m</sup>

Observed by W. E. HARPER  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 7049           |                          |                              |           | 2   | 60 2453           | 2668                     | 0714                         | 29 34     |
| 2   | 76 3139           | 3760                     | 0187                         | 22 25     | 2   | 59 7232           | 7437                     | 0627                         | 25 11     |
| 2   | 74 9780           |                          |                              |           | 2   | 58 3645           | 3830                     | 0767                         | 31 14     |
| 2   | 74 9412           | 9966                     | 0686                         | 31 07     | 2   | 57 4642           | 4818                     | 0701                         | 28 32     |
| 2   | 74 0085           | 0615                     | 0691                         | 31 16     | 2   | 56 3435           |                          |                              |           |
| 2   | 73 3750           |                          |                              |           | 2   | 56 7436           | 7396                     | 0669                         | 26 90     |
| 2   | 72 6176           | 6656                     | 0990                         | 30 77     | 2   | 56 0215           | 0370                     | 0559                         | 22 36     |
| 1½  | 71 7327           |                          |                              |           | 1   | 59 9975           |                          |                              |           |
| 2   | 71 6719           | 7194                     | 0628                         | 27 88     | 2   | 49 3284           | 9324                     | 0677                         | 26 00     |
| 2   | 69 6070           | 6495                     | 0647                         | 28 27     | 2   | 48 0797           | 0787                     | 0806                         | 30 63     |
| 2   | 68 8730           | 9130                     | 0794                         | 34 46     | 2   | 46 4398           |                          |                              |           |
| 2   | 68 5172           | 5572                     | 0705                         | 30 60     | 2   | 46 3377           | 3310                     | 0839                         | 31 46     |
| 2   | 68 5312           |                          |                              |           | 2   | 38 2531           | 2267                     | 0794                         | 28 34     |
| 2   | 67 6069           | 6434                     | 0735                         | 31 75     | 2   | 36 2270           |                          |                              |           |
| 2   | 64 2811           | 3091                     | 0754                         | 31 82     | 2   | 36 0357           | 0627                     | 0878                         | 30 90     |
| 2   | 61 3235           |                          |                              |           | 2   | 33 1311           | 0940                     | 0779                         | 26 87     |

Weighted mean ..... - 29.00  
 $V_a$  ..... + 25.27  
 $V_d$  ..... + 16  
 Curvature ..... - .28  
 Radial velocity ..... - 3.8

$\eta$  BOÖTIS 1307.

1908, Jan. 29,  
G. M. T. 21<sup>h</sup> 14<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 7556           |                          |                              |           | 2   | 59 7720           | 7402                     | 0662                         | 27 12     |
| 1½  | 76 3539           | 3649                     | 0598                         | 27 37     | 2   | 58 4380           | 4930                     | 0567                         | 23 02     |
| 2   | 75 0276           |                          |                              |           | 2   | 57 5179           | 4802                     | 0715                         | 28 86     |
| 2   | 74 9901           | 9980                     | 0660                         | 29 92     | 2   | 56 8023           | 7628                     | 0637                         | 25 59     |
| 2   | 74 0588           | 0640                     | 0666                         | 30 02     | 2   | 56 3977           |                          |                              |           |
| 2   | 73 4219           |                          |                              |           | 1   | 56 0711           | 0390                     | 0629                         | 25 15     |
| 2   | 72 6605           | 6620                     | 0726                         | 32 41     | 2   | 56 0571           |                          |                              |           |
| 3   | 71 7218           | 7208                     | 0614                         | 27 24     | 2   | 49 9803           | 9258                     | 0851                         | 32 70     |
| 2   | 69 6614           | 6552                     | 0590                         | 25 81     | 2   | 48 1479           | 0864                     | 0685                         | 26 01     |
| 2   | 68 9241           | 9159                     | 0765                         | 33 31     | 2   | 46 4998           |                          |                              |           |
| 3   | 68 5710           | 5620                     | 0657                         | 28 53     | 2   | 46 4076           | 3415                     | 0734                         | 27 56     |
| 2   | 68 6280           |                          |                              |           | 2   | 38 3121           | 2251                     | 0810                         | 28 88     |
| 2   | 67 6542           | 6427                     | 0742                         | 32 03     | 2   | 36 2864           |                          |                              |           |
| 2   | 64 3451           | 3251                     | 0594                         | 25 08     | 2   | 36 1037           | 0107                     | 0798                         | 28 06     |
| 2   | 61 3704           |                          |                              |           | 2   | 33 1978           | 0938                     | 0781                         | 26 96     |
| 1½  | 60 2939           | 2634                     | 0748                         | 30 75     | 2   | 33 2792           |                          |                              |           |

Weighted mean ..... - 28.32  
 $V_a$  ..... + 24.95  
 $V_d$  ..... + 13  
 Curvature ..... - .28  
 Radial velocity ..... - 3.5

$\eta$  BOÖTIS 1332.

Feb. 17, 1908.  
G. M. T. 22<sup>h</sup> 30<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 7212           |                          |                              |           | 2   | 58 3842           | 3982                     | 0615                         | 24 97     |
| 2   | 76 3188           | 3628                     | 0619                         | 28 33     | 2   | 57 4824           | 4954                     | 0565                         | 22 80     |
| 2   | 74 9946           |                          |                              |           | 2   | 56 7485           | 7600                     | 0665                         | 26 71     |
| 2   | 74 9565           | 9982                     | 0658                         | 29 83     | 2   | 56 3452           |                          |                              |           |
| 2   | 74 0249           | 0649                     | 0657                         | 29 61     | 1   | 56 0291           | 0393                     | 0536                         | 21 43     |
| 2   | 73 3885           |                          |                              |           | 2   | 53 4001           | 4061                     | 0624                         | 24 52     |
| 2   | 72 6378           | 6756                     | 0590                         | 26 34     | 2   | 49 0003           |                          |                              |           |
| 3   | 71 6874           | 7236                     | 0586                         | 26 00     | 4   | 49 9357           | 9359                     | 0750                         | 28 82     |
| 2   | 69 6200           | 6528                     | 0614                         | 26 86     | 2   | 48 0881           | 0853                     | 0696                         | 26 43     |
| 2   | 68 8936           | 9251                     | 0673                         | 29 30     | 2   | 46 4381           |                          |                              |           |
| 3   | 68 5431           | 5741                     | 0586                         | 23 18     | 2   | 46 3480           | 3422                     | 0727                         | 27 30     |
| 2   | 68 5930           |                          |                              |           | 2   | 38 2439           | 2240                     | 0821                         | 29 28     |
| 3   | 67 6210           | 6505                     | 0664                         | 28 66     | 2   | 36 2164           |                          |                              |           |
| 2   | 64 2952           | 3192                     | 0653                         | 27 57     | 2   | 36 0427           | 0202                     | 0703                         | 24 72     |
| 2   | 61 3281           |                          |                              |           | 2   | 33 1294           | 1019                     | 0700                         | 24 16     |
| 2   | 60 2510           | 2682                     | 0700                         | 28 78     | 2   | 33 2010           |                          |                              |           |
| 2   | 59 7464           | 7629                     | 0435                         | 17 82     |     |                   |                          |                              |           |

Weighted mean ..... - 25 21  
 $V_a$  ..... + 20 45  
 $V_d$  ..... + 12  
 Curvature ..... - 28  
 Radial velocity ..... - 5 2

$\eta$  BOÖTIS 1337.

1908, Feb. 24.  
G. M. T. 19<sup>h</sup> 06<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 76 7176           |                          |                              |           | $\frac{1}{2}$ | 67 6130           | 6450                     | 0719                         | 30 99     |
| 1             | 76 3250           | 3710                     | 0537                         | 24 59     | $\frac{1}{2}$ | 63 2135           | 2395                     | 0700                         | 29 33     |
| $\frac{1}{2}$ | 74 9671           | 0101                     | 0539                         | 24 42     | 2             | 61 3207           |                          |                              |           |
| 2             | 73 3845           |                          |                              |           | 1             | 60 2534           | 2750                     | 0632                         | 25 97     |
| $\frac{1}{2}$ | 72 1053           | 1450                     | 0562                         | 25 06     | $\frac{1}{2}$ | 58 3903           | 4673                     | 0524                         | 21 27     |
| 1             | 71 6970           | 7363                     | 0457                         | 20 34     | 2             | 56 3395           |                          |                              |           |
| 2             | 71 1225           |                          |                              |           | $\frac{1}{2}$ | 56 0048           | 0208                     | 0721                         | 28 84     |
| 2             | 68 5883           |                          |                              |           | $\frac{1}{2}$ | 52 0625           | 0730                     | 0528                         | 20 59     |
| 2             | 68 5422           | 5762                     | 0515                         | 22 35     | 2             | 49 9913           |                          |                              |           |
| $\frac{1}{2}$ | 67 9892           | 0212                     | 0683                         | 26 44     |               |                   |                          |                              |           |

Weighted mean ..... - 25 27  
 $V_a$  ..... + 18 26  
 $V_d$  ..... + 16  
 Curvature ..... - 28  
 Radial velocity ..... - 7 1



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$\eta$  BOÖTIS 1446.

1908. March 30.  
G. M. T. 21<sup>h</sup> 52<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J.

| Region. | Settings I. |             |                            | Settings II. |             |                            | Mean Difference | Velocity. |
|---------|-------------|-------------|----------------------------|--------------|-------------|----------------------------|-----------------|-----------|
|         | Star.       | Comparison. | Difference in Revolutions. | Star.        | Comparison. | Difference in Revolutions. |                 |           |
| 4       | 395         | 424         | 029                        | 350          | 324         | 026                        | 275             | -12.88    |
| 5       | 410         | 435         | 025                        | 336          | 314         | 022                        | 235             | 10.57     |
| 6       | 411         | 437         | 026                        | 346          | 306         | 040                        | 280             | 12.29     |
| 7       | 417         | 446         | 029                        | 330          | 321         | 009                        | 190             | 8.15      |
| 8       | 441         | 465         | 024                        | 317          | 296         | 021                        | 225             | 9.43      |
| 9       | 450         | 471         | 021                        | 320          | 290         | 030                        | 255             | 10.45     |
| 10      | 435         | 475         | 040                        | 304          | 276         | 028                        | 340             | -13.60    |

Standard. . . . . 33  
 Weighted mean . . . . . -10.72  
 $V_a$  . . . . . -3.98  
 $V_d$  . . . . . -25  
 Radial velocity. . . . . -7.0

$\eta$  BOÖTIS 1446.7

1908. Mar. 30.  
G. M. T. 21<sup>h</sup> 52<sup>m</sup>

Observed by W. E. HARPER.  
Measured by C. R. WESTLAND.

| W | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2 | 75.0031           |                          |                              |           | 2   | 58.3770           | 4406                     | 0191                         | 7.75      |
| 2 | 75.0052           | 0377                     | 0263                         | -11.92    | 2   | 57.4580           | 5231                     | 0288                         | 11.62     |
| 2 | 74.0795           | 1152                     | 0154                         | 6.94      | 2   | 56.7254           | 7917                     | 0348                         | 13.98     |
| 2 | 73.3869           |                          |                              |           | 2   | 56.2921           |                          |                              |           |
| 2 | 72.6643           | 7044                     | 0302                         | 13.48     | 1   | 56.0050           | 0732                     | 0197                         | 7.88      |
| 3 | 71.7097           | 7522                     | 0300                         | 13.31     | 2   | 49.9236           |                          |                              |           |
| 2 | 68.9128           | 9623                     | 0301                         | 13.10     | 1   | 49.8982           | 9763                     | 0346                         | 13.20     |
| 2 | 68.5557           | 6061                     | 0216                         | 9.38      | 2   | 48.0465           | 1272                     | 0321                         | 12.19     |
| 2 | 68.5769           |                          |                              |           | 2   | 46.3500           |                          |                              |           |
| 2 | 67.6457           | 6970                     | 0199                         | 9.32      | 2   | 46.3083           | 3908                     | 0241                         | 9.05      |
| 2 | 61.2856           |                          |                              |           | 3   | 38.1702           | 2679                     | 0382                         | -13.62    |
| 2 | 60.2494           | 3100                     | 0232                         | 11.59     | 2   | 36.0923           |                          |                              |           |
| 2 | 59.7264           | 7878                     | 0186                         | 7.62      |     |                   |                          |                              |           |

Weighted mean . . . . . -10.94  
 $V_a$  . . . . . -3.98  
 $V_d$  . . . . . -25  
 Curvature . . . . . -28  
 Radial velocity. . . . . -7.5

\*Check measurement.

1908. March 30.  
G. M. T. 21<sup>h</sup> 52<sup>m</sup>

$\eta$  BOÖTIS 1446.\*

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 76 7922           |                          |                              |           | 1   | 59 7825           | 7820                     | 0244                         | 10.60     |
| 1   | 76 4392           | 4142                     | 0105                         | -4.80     | 1   | 58 4374           | 4384                     | 0213                         | 8.64      |
| 1   | 75 0585           |                          |                              |           | 1   | 57 5302           | 5322                     | 0197                         | 7.95      |
| 1   | 75 0715           | 0465                     | 0175                         | 7.92      | 1   | 56 7981           | 8011                     | 0154                         | 6.19      |
| 2   | 73 4509           |                          |                              |           | 1   | 56 3536           |                          |                              |           |
| 1   | 72 7325           | 7074                     | 0272                         | 12.13     | 2   | 49 9915           |                          |                              |           |
| 2   | 71 7755           | 7505                     | 0317                         | 14.07     | 1   | 49 9582           | 9712                     | 0289                         | 11.09     |
| 1   | 68 9752           | 9542                     | 0382                         | 16.62     | 1   | 48 1122           | 1272                     | 0321                         | 12.19     |
| 1   | 68 6257           | 6047                     | 0230                         | 9.98      | 2   | 46 4180           |                          |                              |           |
| 2   | 68 6416           |                          |                              |           | 1   | 46 3655           | 3845                     | 0304                         | 11.43     |
| 1   | 67 7025           | 6945                     | 0224                         | 9.67      | 1   | 38 2275           | 2595                     | 0466                         | -16.63    |
| 1   | 61 3480           |                          |                              |           | 1   | 36 1572           |                          |                              |           |
| 1   | 60 3231           | 3211                     | 0171                         | 7.02      |     |                   |                          |                              |           |

Weighted mean ..... -10.39  
 $V_a$  ..... +3.98  
 $V_d$  ..... - .25  
 Curvature ..... - .28  
 Radial velocity ..... - 6.9

\*Check measurement.

$\eta$  BOÖTIS 1513.

1908. May 4.  
G. M. T. 18<sup>h</sup> 13<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 75 1160           |                          |                              |           | 2   | 63 3747           |                          |                              |           |
| 2   | 74 2116           | 2076                     | 0087                         | + 3.91    | 1   | 63 3747           | 3635                     | 0061                         | 2.55      |
| 2   | 73 4946           |                          |                              |           | 1   | 60 3917           | 3785                     | 0109                         | 4.47      |
| 2   | 72 8126           | 8070                     | 0080                         | 3.55      | 1   | 59 8668           | 8533                     | 0189                         | 7.71      |
| 1   | 72 5446           | 5394                     |                              |           | 2   | 58 8243           |                          |                              |           |
| 2   | 72 2822           | 2770                     | 0131                         | 5.82      | 2   | 58 5330           | 5188                     | 0112                         | 4.54      |
| 2   | 71 8622           | 8567                     | 0128                         | 5.68      | 1   | 56 8700           | 8540                     | 0081                         | 3.24      |
| 1½  | 69 7922           | 7857                     | 0155                         | 6.76      | 2   | 56 3934           |                          |                              |           |
| 1   | 69 0562           | 0492                     |                              |           | 2   | 53 9788           |                          |                              |           |
| 1   | 68 7040           | 6967                     | 0159                         | 6.92      | 1   | 52 1672           | 1482                     | 0164                         | 6.36      |
| 2   | 68 6835           |                          |                              |           | 1   | 48 1835           | 1620                     | 0087                         | + 3.30    |
| 1   | 67 7903           | 7823                     | 0150                         | 6.46      | 2   | 46 4436           |                          |                              |           |
| 1   | 65 5145           | 5350                     | 0056                         | 2.37      |     |                   |                          |                              |           |

Weighted mean ..... + 4.91  
 $V_a$  ..... -11.19  
 $V_d$  ..... - .17  
 Curvature ..... - .28  
 Radial velocity ..... - 6.7

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1908, May 23,  
G. M. T. 16<sup>h</sup> 00<sup>m</sup>

$\eta$  BOÖTIS 1557.

Observed by J. S. PLASKETT,  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 76 9548           |                          |                              |           | 1   | 68 2353           | 2063                     | 0138                         | 5 93      |
| 1   | 76 9700           | 9334                     | 0152                         | 6 93      | 2   | 67 4918           | 4461                     | 0085                         | 3 63      |
| 1   | 76 6302           | 5937                     | 0200                         | 9 10      | 1   | 63 4283           |                          |                              |           |
| 1   | 75 2687           | 2326                     | 0273                         | 12 31     | 1   | 59 9277           | 8962                     | 0339                         | 13 79     |
| 2   | 75 2128           |                          |                              |           | 1   | 59 3672           | 3358                     | 0362                         | 14 69     |
| 2   | 73 5876           |                          |                              |           | 2   | 56 4245           |                          |                              |           |
| 1   | 72 9026           | 8696                     | 0064                         | 2 84      | 1   | 52 7616           | 7366                     | 0368                         | 11 98     |
| 1½  | 71 9679           | 9359                     | 0303                         | 13 36     | 1   | 50 0213           |                          |                              |           |
| 1   | 71 9354           |                          |                              |           | 1½  | 48 1823           | 1643                     | 0168                         | 6 35      |
| 2   | 69 1577           | 1285                     | 0283                         | 12 25     | 2   | 46 4392           | 4238                     | 0315                         | 11 74     |
| 1   | 68 7609           |                          |                              |           | 2   | 46 4258           |                          |                              |           |

Weighted mean . . . . . 9 6  
 $V_a$  . . . . . -17 97  
 $V_d$  . . . . . - 10  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 8 7

1908, May 25,  
G. M. T. 15<sup>h</sup> 58<sup>m</sup>

$\eta$  BOÖTIS 1553.

Observed by T. H. PARKER,  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 9679           |                          |                              |           | 2   | 68 7945           | 8690                     | 0225                         | 9 69      |
| 1   | 77 3242           | 3499                     | 0444                         | 20 24     | 2   | 68 7744           |                          |                              |           |
| 1   | 76 6597           | 6853                     | 0371                         | 16 84     | 2   | 67 8874           | 9004                     | 0322                         | 13 78     |
| ½   | 76 4693           | 4923                     | 0189                         | 8 58      | 2   | 64 5208           | 5278                     | 0202                         | 8 46      |
| 1   | 75 2271           |                          |                              |           | 1   | 63 4552           | 4606                     | 0371                         | 15 43     |
| 2   | 74 3368           | 3568                     | 0215                         | 9 61      | 2   | 63 4326           |                          |                              |           |
| 2   | 73 6031           |                          |                              |           | 1   | 61 4657           | 4657                     | 0300                         | 12 30     |
| 2   | 72 3932           | 4112                     | 0210                         | 9 26      | 2   | 60 4492           | 4482                     | 0214                         | 8 73      |
| 1   | 71 9847           | 0027                     | 0354                         | 15 57     | 2   | 59 9312           | 9297                     | 0394                         | 15 99     |
| 2   | 71 3184           |                          |                              |           | 2   | 59 3758           | 3723                     | 0464                         | 18 83     |
| 2   | 69 8968           | 9123                     | 0302                         | 13 10     | 2   | 58 8903           | 8853                     | 0275                         | 11 08     |
| 1   | 69 1583           | 1728                     | 0186                         | 8 03      | 2   | 56 4272           |                          |                              |           |

Weighted mean . . . . . 12 38  
 $V_a$  . . . . . -18 59  
 $V_d$  . . . . . - 10  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 6 6

$\eta$  BOÖTIS 1553.\*

1908. May 23.  
G. M. T. 15<sup>h</sup> 58<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 8899           |                          |                              |           | 2   | 68 7225           | 8120                     | 0255                         | 10 99     |
| 1   | 77 2379           | 3419                     | 0364                         | +16 60    | 2   | 68 6957           |                          |                              |           |
| 2   | 76 5803           | 6833                     | 0351                         | 15 93     | 2   | 67 8170           | 9050                     | 0368                         | 15 73     |
| 1   | 76 3967           | 4997                     | 0263                         | 11 91     | 2   | 64 4485           | 5294                     | 0219                         | 9 24      |
| 2   | 75 1498           |                          |                              |           | 2   | 63 3766           | 4560                     | 0325                         | 13 52     |
| 3   | 74 2572           | 3557                     | 0202                         | 9 03      | 2   | 63 3594           |                          |                              |           |
| 2   | 73 5255           |                          |                              |           | 1   | 61 3866           | 4610                     | 0253                         | 10 37     |
| 2   | 72 3153           | 4103                     | 0201                         | 8 84      | 2   | 60 3764           | 4489                     | 0221                         | 9 02      |
| 2   | 71 9030           | 9973                     | 0300                         | 13 20     | 2   | 59 8471           | 9186                     | 0283                         | 11 49     |
| 2   | 71 8607           |                          |                              |           | 1   | 59 2900           | 3600                     | 0341                         | 13 78     |
| 2   | 71 2438           |                          |                              |           | 2   | 58 8184           | 8874                     | 0296                         | -11 96    |
| 2   | 69 8265           | 9175                     | 0354                         | 15 36     | 2   | 56 3496           |                          |                              |           |
| 2   | 69 0868           | 1768                     | 0226                         | 9 76      |     |                   |                          |                              |           |

Weighted mean ..... -12 16  
 $V_a$  ..... -18 59  
 $V_d$  ..... - 10  
 Curvature ..... - 28  
 Radial velocity ..... - 6 8

\*Different standard.

$\eta$  BOÖTIS 1621.

1908. June 22.  
G. M. T. 14<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 8898           |                          |                              |           | 2   | 67 8377           | 8610                     | 0432                         | 18 53     |
| 2   | 76 5947           | 6227                     | 0450                         | +20 47    | 2   | 65 5907           | 6127                     | 0392                         | 16 58     |
| 2   | 74 2843           | 3110                     | 0440                         | 19 71     | 2   | 64 4965           | 5180                     | 0514                         | 21 59     |
| 2   | 74 0261           | 0526                     | 0477                         | 21 32     | 2   | 63 3773           |                          |                              |           |
| 2   | 73 5353           |                          |                              |           | 2   | 60 4210           | 4413                     | 0439                         | 17 91     |
| 2   | 72 8694           | 8954                     | 0322                         | 14 30     | 2   | 59 8945           | 9145                     | 0522                         | 21 24     |
| 2   | 72 5840           | 6100                     | 0353                         | 15 64     | 2   | 58 8142           |                          |                              |           |
| 2   | 72 3438           | 3693                     | 0418                         | 18 47     | 2   | 58 8748           | 8948                     | 0620                         | 25 04     |
| 3   | 71 9275           | 9528                     | 0472                         | 20 81     | 2   | 58 5401           | 5601                     | 0521                         | 20 37     |
| 2   | 71 2520           |                          |                              |           | 2   | 58 9551           |                          |                              |           |
| 2   | 69 8502           | 8744                     | 0483                         | 21 01     | 2   | 52 1673           | 7880                     | 0505                         | -19 54    |
| 3   | 68 7500           | 7735                     | 0400                         | 17 28     | 2   | 49 9791           |                          |                              |           |
| 2   | 68 7025           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... +19 40  
 $V_a$  ..... -24 75  
 $V_d$  ..... - 17  
 Curvature ..... - 28  
 Radial velocity ..... - 5 8

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$\eta$  BOÖTIS 1621.\*

1908, June 22,  
G. M. T. 14<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 76 9515           |                          |                              |           | 3   | 67 8975           | 8633                     | 0455                         | 20 88     |
| 2   | 76 6545           | 6195                     | 0458                         | +20 84    | 2   | 65 6520           | 6150                     | 0415                         | 17 55     |
| 2   | 74 3483           | 3118                     | 0448                         | 20 07     | 2   | 64 5563           | 5168                     | 0502                         | 21 08     |
| 2   | 74 0780           | 0418                     | 0369                         | 16 50     | 2   | 63 4410           |                          |                              |           |
| 2   | 73 5981           |                          |                              |           | 2   | 60 4858           | 4438                     | 0464                         | 18 93     |
| 2   | 72 9294           | 8934                     | 0302                         | 13 40     | 2   | 59 9466           | 9046                     | 0423                         | 17 22     |
| 2   | 72 6463           | 6103                     | 0356                         | 15 77     | 2   | 58 8764           |                          |                              |           |
| 2   | 72 4084           | 3722                     | 0347                         | 15 34     | 2   | 58 9274           | 8859                     | 0531                         | 21 45     |
| 2   | 71 9888           | 9527                     | 0471                         | 20 77     | 2   | 58 5948           | 5533                     | 0453                         | 17 71     |
| 2   | 71 3110           |                          |                              |           | 2   | 54 0116           |                          |                              |           |
| 2   | 69 9688           | 8748                     | 0487                         | 21 18     | 2   | 52 2260           | 1960                     | 0585                         | +22 64    |
| 2   | 68 8137           | 7802                     | 0467                         | 20 17     | 2   | 50 0224           |                          |                              |           |
| 2   | 68 7675           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... -18 91  
 $V_a$  ..... -24 75  
 $V_d$  ..... 17  
 Curvature ..... -28  
 Radial velocity..... - 6.3

\*Check measurement.

$\eta$  BOÖTIS 1663.\*

1908, July 6,  
G. M. T. 14<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Region. | Settings I. |             |                            | Settings II. |             |                            | Mean Difference | Velocity. |
|---------|-------------|-------------|----------------------------|--------------|-------------|----------------------------|-----------------|-----------|
|         | Star.       | Comparison. | Difference in Revolutions. | Star.        | Comparison. | Difference in Revolutions. |                 |           |
| 6       | 325         | 359         | 034                        | 688          | 643         | 045                        | 040             | +19 04    |
| 7       | 334         | 363         | 029                        | 686          | 641         | 045                        | 037             | 16 98     |
| 8       | 341         | 378         | 037                        | 668          | 632         | 036                        | 036             | 15 95     |
| 9       | 334         | 378         | 044                        | 676          | 632         | 044                        | 044             | 18 92     |
| 10      | 347         | 387         | 040                        | 672          | 619         | 053                        | 046             | 19 14     |
| 11      | 350         | 403         | 053                        | 660          | 603         | 057                        | 055             | 22 11     |
| 12      | 372         | 411         | 039                        | 650          | 603         | 047                        | 043             | 16 65     |
| 13      | 368         | 414         | 046                        | 650          | 605         | 045                        | 046             | 17 30     |
| 14      | 378         | 425         | 047                        | 650          | 600         | 050                        | 048             | 17 47     |
| 15      | 397         | 445         | 048                        | 634          | 579         | 055                        | 052             | 18 30     |
| 16      | 407         | 458         | 051                        | 628          | 564         | 064                        | 057             | 19 49     |
| 17      | 430         | 467         | 037                        | 604          | 554         | 050                        | 044             | +14 56    |

Weighted mean ..... +17 99  
 1519 Standard ..... + 41  
 $V_s$  ..... -18 40  
 $V_a$  ..... -25 77  
 $V_d$  ..... 17  
 Radial velocity..... - 7.6

1908, July 6,  
G. M. T. 14<sup>h</sup> 40<sup>m</sup> $\eta$  BOÖTIS 1663.Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Region. | Settings I. |             | Difference<br>in<br>Revolutions. | Settings II. |             | Difference<br>in<br>Revolutions. | Mean<br>Difference | Velocity. |
|---------|-------------|-------------|----------------------------------|--------------|-------------|----------------------------------|--------------------|-----------|
|         | Star.       | Comparison. |                                  | Star.        | Comparison. |                                  |                    |           |
| 5       | 021         | 970         | 051                              | 205          | 246         | 041                              | 046                | +22.72    |
| 6       | 009         | 975         | 034                              | 201          | 250         | 019                              | 042                | 29.00     |
| 7       | 021         | 966         | 056                              | 206          | 254         | 048                              | 052                | 23.87     |
| 8       | 021         | 965         | 056                              | 212          | 251         | 039                              | 047                | 20.82     |
| 9       | 009         | 967         | 042                              | 213          | 253         | 040                              | 041                | 17.63     |
| 10      | 995         | 958         | 037                              | 220          | 266         | 046                              | 011                | 17.06     |
| 11      | 008         | 955         | 053                              | 229          | 270         | 041                              | 047                | 18.89     |
| 12      | 984         | 949         | 035                              | 219          | 284         | 065                              | 050                | 19.41     |
| 13      | 973         | 944         | 029                              | 241          | 283         | 042                              | 036                | 13.54     |
| 14      | 989         | 927         | 062                              | 240          | 284         | 044                              | 053                | 19.29     |
| 15      | 970         | 914         | 056                              | 250          | 301         | 051                              | 053                | 18.66     |
| 16      | 967         | 917         | 050                              | 255          | 311         | 056                              | 053                | 18.13     |
| 17      | 950         | 905         | 045                              | 265          | 319         | 054                              | 048                | 15.89     |
| 18      | 931         | 890         | 041                              | 285          | 324         | 039                              | 040                | 12.82     |
| 19      | 942         | 877         | 065                              | 291          | 335         | 044                              | 054                | +16.74    |

Weighted mean ..... +18.36  
1520 Standard ..... +.38 $V_s$  ..... -18.74  
 $V_o$  ..... -25.77  
 $V_d$  ..... -17

Radial velocity ..... -7.2

1908, July 15,  
G. M. T. 14<sup>h</sup> 41<sup>m</sup> $\eta$  BOÖTIS 1710.Observed by J. B. CANNON.  
Measured by W. E. HARPER.

| Region. | Settings I. |             | Difference<br>in<br>Revolutions. | Settings II. |             | Difference<br>in<br>Revolutions. | Mean<br>Difference | Velocity. |
|---------|-------------|-------------|----------------------------------|--------------|-------------|----------------------------------|--------------------|-----------|
|         | Star.       | Comparison. |                                  | Star.        | Comparison. |                                  |                    |           |
| 6       | 435         | 396         | 039                              | 456          | 405         | 051                              | 045                | +21.42    |
| 7       | 426         | 386         | 040                              | 445          | 407         | 038                              | 039                | 17.90     |
| 8       | 426         | 386         | 040                              | 442          | 391         | 051                              | 045                | 19.93     |
| 9       | 448         | 395         | 053                              | 439          | 392         | 047                              | 050                | 21.50     |
| 10      | 448         | 400         | 048                              | 434          | 395         | 039                              | 043                | 17.89     |
| 11      | 454         | 391         | 063                              | 426          | 383         | 043                              | 053                | 21.31     |
| 12      | 436         | 399         | 037                              | 441          | 400         | 044                              | 040                | 15.53     |
| 13      | 448         | 400         | 048                              | 444          | 375         | 069                              | 058                | 21.81     |
| 14      | 455         | 405         | 050                              | 439          | 400         | 039                              | 045                | 16.38     |
| 15      | 451         | 396         | 055                              | 450          | 390         | 060                              | 057                | 29.06     |
| 16      | 461         | 391         | 070                              | 451          | 395         | 056                              | 063                | 21.55     |
| 17      | 425         | 390         | 035                              | 452          | 398         | 054                              | 044                | +14.56    |

Weighted mean ..... -19.15  
1520 Standard ..... +.38 $V_s$  ..... +19.53  
 $V_o$  ..... -25.71  
 $V_d$  ..... -24

Radial velocity ..... -6.4

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$\eta$  BOÖTIS 1792

1908, Aug. 19,  
G. M. T. 13<sup>h</sup> 18<sup>m</sup>

Observed by W. E. HARPER,  
Measured by T. H. PARKER.

| Region. | Settings I. |             | Difference<br>in<br>Revolutions | Settings II. |            | Difference<br>in<br>Revolutions. | Mean<br>Difference | Velocity. |
|---------|-------------|-------------|---------------------------------|--------------|------------|----------------------------------|--------------------|-----------|
|         | Star        | Comparison. |                                 | Star         | Comparison |                                  |                    |           |
| 5       | 802         | 817         | 015                             | 718          | 690        | 028                              | 022                | +10 86    |
| 6       | 812         | 824         | 012                             | 697          | 673        | 024                              | 018                | 8 56      |
| 7       | 815         | 834         | 019                             | 710          | 671        | 039                              | 029                | 13 31     |
| 8       | 829         | 846         | 017                             | 693          | 670        | 023                              | 026                | 11 51     |
| 9       | 828         | 841         | 013                             | 681          | 660        | 021                              | 025                | 10 72     |
| 10      | 831         | 860         | 029                             | 685          | 654        | 031                              | 030                | 12 45     |
| 11      | 837         | 865         | 028                             | 682          | 644        | 038                              | 033                | 13 23     |
| 12      | 842         | 868         | 026                             | 687          | 654        | 033                              | 029                | 11 25     |
| 13      | 853         | 885         | 042                             | 668          | 610        | 058                              | 035                | 13 16     |
| 14      | 865         | 895         | 030                             | 660          | 619        | 041                              | 036                | 13 10     |
| 15      | 864         | 902         | 039                             | 636          | 600        | 036                              | 037                | 13 02     |
| 16      | 876         | 909         | 033                             | 637          | 591        | 046                              | 039                | +13 29    |

Weighted mean ..... +12 04  
 1519 Standard ..... + 41  
 $V_a$  ..... - 20 04  
 $V_d$  ..... - 28  
 Radial velocity ..... - 7 9

$\eta$  BOÖTIS 1867.

1908, Sept. 7,  
G. M. T. 12<sup>h</sup> 57<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by J. B. CANNON.

| Wt. | Mean<br>of<br>Settings. | Corrected<br>Star<br>Settings. | Displace-<br>ment in<br>Revolutions. | Velocity. | Wt. | Mean<br>of<br>Settings. | Corrected<br>Star<br>Settings. | Displace-<br>ment in<br>Revolutions. | Velocity. |
|-----|-------------------------|--------------------------------|--------------------------------------|-----------|-----|-------------------------|--------------------------------|--------------------------------------|-----------|
| 2   | 76 9031                 | .....                          | .....                                | .....     | 2   | 71 8856                 | .....                          | .....                                | .....     |
| 1½  | 77 2356                 | 2508                           | 0215                                 | + 9 80    | 1   | 68 7611                 | 7763                           | 0428                                 | 18 49     |
| 1½  | 76 6039                 | 6189                           | 0452                                 | 20 61     | 2   | 68 7171                 | .....                          | .....                                | .....     |
| 1   | 75 8642                 | 8777                           | 0405                                 | 18 35     | 1   | 67 8216                 | 8366                           | 0188                                 | 8 06      |
| 1½  | 72 8696                 | 8798                           | 0166                                 | 7 37      | 2   | 63 3916                 | .....                          | .....                                | .....     |
| 1½  | 72 5992                 | 6116                           | 0369                                 | 16 35     | 1   | 60 4216                 | 1276                           | 0302                                 | 12 35     |
| 2   | 71 9211                 | 9371                           | 0315                                 | 13 89     | ½   | 59 3391                 | 3441                           | 0545                                 | 22 13     |

Weighted mean ..... +14 18  
 $V_a$  ..... - 13 88  
 $V_d$  ..... - 39  
 Curvature ..... - 28  
 Radial velocity ..... - 0 3

$\eta$  BOÖTIS 2115.

1909. Jan. 7.  
G. M. T. 23<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|------------------|--------------------------|------------------------------|-----------|
| 2   | 76 6775           |                          |                              |           | 2   | 69 3445          | 3612                     | 0260                         | 11 39     |
| 2   | 76 6430           | 6575                     | 0344                         | -15 82    | 2   | 68 8810          | 9002                     | 0381                         | 16 65     |
| 2   | 76 3060           | 3200                     | 0301                         | 13 79     | 2   | 68 5537          |                          |                              |           |
| 2   | 74 9547           |                          |                              |           | 2   | 68 5247          | 5245                     | 0502                         | 21 80     |
| 1   | 74 9365           | 9467                     | 0464                         | 21 11     | 2   | 67 6056          | 6244                     | 0421                         | 18 24     |
| 1   | 74 0052           | 0152                     | 0471                         | 21 29     | 2   | 67 2315          | 2501                     | 0393                         | 17 02     |
| 2   | 73 7510           | 7610                     | 0413                         | 18 63     | 2   | 65 3890          | 4052                     | 0359                         | 15 30     |
| 2   | 73 3481           |                          |                              |           | 1   | 64 2927          | 3075                     | 0360                         | 15 30     |
| 2   | 72 6167           | 6277                     | 0425                         | 19 08     | 2   | 63 2724          |                          |                              |           |
| 2   | 72 3162           | 3279                     | 0560                         | 25 09     | 2   | 63 2091          | 2230                     | 0486                         | 20 41     |
| 2   | 71 6667           | 6810                     | 0394                         | 17 53     | 2   | 58 7025          | 7188                     | 0387                         | -15 79    |
| 2   | 71 0812           |                          |                              |           | 2   | 58 7427          |                          |                              |           |
| 2   | 69 6012           | 6173                     | 0409                         | 17 91     |     |                  |                          |                              |           |

Weighted mean..... 17 88  
 $V_a$ ..... +26 69  
 $V_d$ ..... + 04  
 Curvature..... - 28  
 Radial velocity..... + 8 6

$\eta$  BOÖTIS 2209.

1909. Jan. 30.  
G. M. T. 18<sup>h</sup> 37<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|------------------|--------------------------|------------------------------|-----------|
| 2             | 81 7544           |                          |                              |           | 1             | 67 6626          | 6721                     | 0448                         | 19 35     |
| 1             | 80 5548           | 5772                     | 0398                         | -18 75    | $\frac{1}{2}$ | 66 5389          | 5481                     | 0351                         | 15 02     |
| 2             | 76 7524           |                          |                              |           | $\frac{1}{2}$ | 64 3381          | 3469                     | 0376                         | 15 87     |
| 1             | 76 7084           | 7234                     | 0440                         | 20 20     | 2             | 61 3366          |                          |                              |           |
| 1             | 76 3728           | 3878                     | 0369                         | 16 90     | $\frac{1}{2}$ | 61 1268          | 1347                     | 0458                         | 18 92     |
| $\frac{1}{2}$ | 75 0031           | 0159                     | 0481                         | 21 79     | $\frac{1}{2}$ | 59 7626          | 7719                     | 0355                         | 14 55     |
| $\frac{1}{2}$ | 74 0754           | 0862                     | 0444                         | 20 02     | 1             | 58 4051          | 4151                     | 0446                         | 18 11     |
| 2             | 73 4156           |                          |                              |           | $\frac{1}{2}$ | 52 0778          | 0920                     | 0338                         | 13 18     |
| 1             | 72 6808           | 6896                     | 0450                         | 20 07     | 2             | 49 9854          |                          |                              |           |
| 2             | 71 7318           | 7410                     | 0412                         | 18 29     | 1             | 48 0966          | 1130                     | 0463                         | -17 59    |
| 2             | 68 6164           |                          |                              |           |               |                  |                          |                              |           |

Weighted mean..... -19 76  
 $V_a$ ..... +25 02  
 $V_d$ ..... + 20  
 Curvature..... - 28  
 Radial velocity..... + 5 2



SESSIONAL PAPER No. 25a

$\eta$  BOÖTIS 2283.

1909. Feb 17.  
G. M. T. 20<sup>h</sup> 30<sup>m</sup>

Observed by  $\frac{1}{f}$  J. B. CANNON.  
Measured by  $\frac{1}{f}$

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 76.7061           |                          |                              |           | 1             | 61.0771           | 1522                     | 0283                         | 11.70     |
| $\frac{1}{2}$ | 76.6704           | 7317                     | 0357                         | 16.38     | 1             | 59.6981           | 7740                     | 0324                         | 13.27     |
| 1             | 74.9769           | 0382                     | 0258                         | 11.70     | 1             | 56.7111           | 7913                     | 0342                         | 13.74     |
| $\frac{1}{2}$ | 74.0486           | 1100                     | 0206                         | 9.28      | 2             | 56.2824           |                          |                              |           |
| 1             | 73.0121           | 0736                     | 0474                         | 21.21     | $\frac{1}{2}$ | 52.9986           | 0808                     | 0450                         | 17.53     |
| 2             | 73.3628           |                          |                              |           | 1             | 51.6967           | 7801                     | 0303                         | 11.78     |
| 1             | 72.1104           | 1739                     | 0272                         | 12.10     | $\frac{1}{2}$ | 49.8821           | 9680                     | 0321                         | 12.34     |
| 2             | 71.6891           | 7546                     | 0276                         | 12.24     | $\frac{1}{2}$ | 48.0301           | 1171                     | 0378                         | 14.35     |
| 1             | 69.6231           | 6925                     | 0217                         | 9.49      | 2             | 46.3428           |                          |                              |           |
| 2             | 68.5548           |                          |                              |           | 1             | 46.2721           | 3617                     | 0532                         | 19.97     |
| 1             | 68.5298           | 6012                     | 0265                         | 11.51     | 2             | 33.0633           |                          |                              |           |
| $\frac{1}{2}$ | 67.6224           | 6945                     | 0224                         | 9.67      | $\frac{1}{2}$ | 31.5776           | 6899                     | 0444                         | 15.19     |
| 2             | 63.2498           |                          |                              |           | 1             | 30.8284           | 9422                     | 0517                         | 17.61     |
| 1             | 63.1931           | 2674                     | 0421                         | 17.65     | $\frac{1}{2}$ | 26.4908           | 6107                     | 0496                         | 16.44     |

Weighted mean ..... - 13.98  
 $V_a$  ..... + 20.25  
 $V_d$  ..... + .04  
 Curvature ..... - .28  
 Radial velocity ..... + 6.0

$\eta$  BOÖTIS 2396.

1909. March 20.  
G. M. T. 17<sup>h</sup> 00<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 77.1341           |                          |                              |           | 1   | 68.6049           | 6109                     | 0168                         | 7.29      |
| 1             | 76.7516           | 7465                     | 0209                         | 9.59      | 1   | 67.6992           | 7072                     | 0097                         | 4.19      |
| $\frac{1}{2}$ | 76.4234           | 4178                     | 0060                         | 2.75      | 2   | 61.3224           |                          |                              |           |
| 1             | 75.0522           | 0491                     | 0149                         | 6.75      | 1   | 60.3016           | 3269                     | 0113                         | 4.64      |
| 1             | 74.1209           | 1191                     | 0115                         | 5.19      | 1   | 59.7754           | 8027                     | 0037                         | 1.51      |
| 2             | 73.4249           |                          |                              |           | 1   | 58.4149           | 4462                     | 0135                         | 5.48      |
| 1             | 72.7076           | 7079                     | 0267                         | 11.91     | 2   | 49.9442           |                          |                              |           |
| $\frac{1}{2}$ | 72.4506           | 4318                     | 0157                         | 7.00      | 1   | 49.9466           | 0041                     | 0068                         | 2.61      |
| 2             | 71.7064           | 7688                     | 0134                         | 5.95      | 2   | 30.9059           |                          |                              |           |
| 2             | 71.1534           |                          |                              |           | 1   | 30.8756           | 9795                     | 0144                         | 4.91      |
| 1             | 69.7034           | 7074                     | 0068                         | 2.97      |     |                   |                          |                              |           |

Weighted mean ..... - 5.59  
 $V_a$  ..... + 8.52  
 $V_d$  ..... + .14  
 Curvature ..... - .28  
 Radial velocity ..... + 2.8

OBSERVING RECORD AND DETAILED MEASURES OF  $\alpha$  CORONAE BOREALIS.

P.—PLASKETT.  
 Pl.—PARKER.  
 H.—HARPER.  
 C.—CANNON.  
 T.—TRIBBLE.

RECORD OF SPECTROGRAMS.

| STAR.                       | No. of Negative. | Camera. | Plate. | Date.   | Middle of Exposure. |     | Duration. | Hour Angle at end. | TEMPERATURE. Centigrade. |      |            |      | Slit Width. | Seeing.  | Observer      |   |
|-----------------------------|------------------|---------|--------|---------|---------------------|-----|-----------|--------------------|--------------------------|------|------------|------|-------------|----------|---------------|---|
|                             |                  |         |        |         | G. M. T.            |     |           |                    | Room.                    |      | Prism Box. |      |             |          |               |   |
|                             |                  |         |        |         | h. m.               | na. |           |                    | Beg.                     | End. | Beg.       | End. |             |          |               |   |
| $\alpha$ Coronae Borealis : | 784              | II      | Seed   | 27. May | 24 17               | 43  | 10        | 1                  | 20W.                     | 9 0  | 9 4        | 16 4 | 16 4        | 001      | Fair....      | P |
| "                           | 790              | "       | "      | "       | 29 15               | 14  | 12        | 1                  | 50W.                     | 8 9  | 9 0        | 14 5 | 14 5        | 001      | "             | P |
| "                           | 800              | "       | "      | "       | 31 17               | 18  | 8         | 1                  | 20W.                     | 13 0 | 12 8       | 18 8 | 18 8        | 001      | Good....      | P |
| "                           | 808              | "       | "      | June    | 8 16                | 28  | 10        | 1                  | 65W.                     | 15 4 | 15 2       | 17 2 | 17 2        | 001      | "             | P |
| "                           | 813              | "       | "      | "       | 10 15               | 23  | 10        | 0                  | 00                       | 14 8 | 14 6       | 18 1 | 18 1        | 001      | "             | P |
| "                           | 830              | "       | "      | "       | 11 17               | 40  | 10        | 2                  | 15W.                     | 14 0 | 14 0       | 18 9 | 18 9        | 001      | Fair....      | H |
| "                           | 837a             | "       | "      | "       | 12 17               | 36  | 12        | 2                  | 30W.                     | 17 0 | 16 3       | 19 0 | 19 0        | 001      | "             | P |
| "                           | 837b             | "       | "      | "       | 12 17               | 52  | 12        | 2                  | 42W.                     | 16 0 | 15 6       | 19 0 | 19 0        | 001      | "             | P |
| "                           | 845              | "       | "      | "       | 13 16               | 32  | 15        | 1                  | 30W.                     | 19 8 | 19 4       | 25 8 | 25 8        | 0012     | "             | H |
| "                           | 850a             | "       | "      | "       | 14 16               | 39  | 12        | 1                  | 40W.                     | 21 6 | 21 4       | 23 3 | 23 3        | 0012     | "             | P |
| "                           | 850b             | "       | "      | "       | 14 16               | 52  | 5         | 1                  | 50W.                     | 21 4 | 21 1       | 23 3 | 23 3        | 0012     | Good....      | P |
| "                           | 869a             | "       | "      | "       | 21 15               | 10  | 15        | 1                  | 50W.                     | 24 8 | 24 8       | 28 9 | 28 9        | 001      | Hazy....      | P |
| "                           | 869b             | "       | "      | "       | 21 15               | 42  | 15        | 1                  | 20W.                     | 24 8 | 24 6       | 28 9 | 29 0        | 001      | "             | P |
| "                           | 892a             | "       | "      | "       | 27 15               | 25  | 10        | 1                  | 17W.                     | 21 2 | 20 9       | 24 5 | 24 5        | 0012     | Fair....      | H |
| "                           | 892b             | "       | "      | "       | 27 15               | 37  | 5         | 1                  | 25W.                     | 20 9 | 20 9       | 24 5 | 24 5        | 0012     | Cloudy.       | T |
| "                           | 903a             | "       | "      | "       | 28 14               | 36  | 13        | 33W.               | 23 8                     | 23 6 | 26 4       | 26 3 | 0012        | Fair.... | P             |   |
| "                           | 903b             | "       | "      | "       | 28 14               | 57  | 25        | 1                  | 00W.                     | 23 5 | 22 8       | 26 3 | 26 2        | 0012     | "             | P |
| "                           | 912a             | "       | "      | July    | 4 15                | 38  | 10        | 2                  | 00W.                     | 21 0 | 20 5       | 29 0 | 28 8        | 0012     | Good....      | H |
| "                           | 912b             | "       | "      | "       | 4 15                | 47  | 5         | 2                  | 17W.                     | 21 0 | 20 6       | 28 8 | 28 6        | 0012     | "             | H |
| "                           | 917              | "       | "      | "       | 5 15                | 20  | 10        | 1                  | 45W.                     | 21 0 | 20 8       | 26 4 | 26 4        | 0011     | "             | P |
| "                           | 919              | "       | "      | "       | 8 15                | 36  | 22        | 2                  | 05W.                     | 21 2 | 21 2       | 22 4 | 22 4        | 0012     | Fair....      | P |
| "                           | 927              | "       | "      | "       | 9 14                | 32  | 15        | 1                  | 14W.                     | 23 1 | 23 1       | 24 5 | 24 5        | 0012     | Good....      | H |
| "                           | 939a             | "       | "      | "       | 12 16               | 25  | 10        | 4                  | 15W.                     | 22 6 | 22 4       | 26 0 | 26 0        | 0012     | "             | P |
| "                           | 939b             | "       | "      | "       | 12 16               | 33  | 23        | 4                  | 20W.                     | 22 6 | 22 4       | 26 0 | 26 0        | 0012     | "             | P |
| "                           | 941a             | "       | "      | "       | 13 15               | 25  | 10        | 3                  | 15W.                     | 18 2 | 18 0       | 25 2 | 25 0        | 0012     | "             | T |
| "                           | 941b             | "       | "      | "       | 13 15               | 32  | 3         | 3                  | 20W.                     | 18 0 | 17 8       | 25 0 | 25 0        | 0012     | "             | T |
| "                           | 944a             | "       | "      | "       | 16 14               | 37  | 13        | 1                  | 42W.                     | 25 5 | 25 5       | 26 8 | 26 8        | 0012     | Unst'dy       | T |
| "                           | 944b             | "       | "      | "       | 16 14               | 49  | 6         | 1                  | 53W.                     | 25 5 | 25 5       | 26 8 | 26 8        | 0012     | "             | T |
| "                           | 951a             | "       | "      | "       | 18 14               | 50  | 60        | 2                  | 32W.                     | 26 0 | 25 0       | 28 5 | 28 5        | 0012     | Very hazy..   | T |
| "                           | 951b             | "       | "      | "       | 18 15               | 32  | 5         | 2                  | 45W.                     | 22 5 | 22 5       | 28 5 | 28 5        | 0012     | "             | H |
| "                           | 956a             | "       | "      | "       | 20 16               | 07  | 14        | 3                  | 30W.                     | 19 2 | 18 6       | 21 6 | 21 6        | 0012     | Good....      | P |
| "                           | 956b             | "       | "      | "       | 20 16               | 17  | 2         | 3                  | 32W.                     | 19 2 | 18 6       | 21 6 | 21 6        | 0012     | "             | P |
| "                           | 963a             | "       | "      | "       | 23 14               | 32  | 6         | 2                  | 05W.                     | 23 2 | 23 2       | 26 4 | 26 4        | 0012     | "             | T |
| "                           | 963b             | "       | "      | "       | 23 14               | 41  | 3         | 2                  | 15W.                     | 22 6 | 22 6       | 26 4 | 26 4        | 0012     | "             | T |
| "                           | 973a             | "       | "      | Aug.    | 1 14                | 06  | 12        | 2                  | 15W.                     | 21 3 | 21 0       | 25 2 | 25 2        | 0008     | "             | H |
| "                           | 973b             | "       | "      | "       | 1 14                | 18  | 8         | 2                  | 26W.                     | 21 0 | 19 5       | 25 2 | 25 2        | 0008     | "             | H |
| "                           | 978              | "       | "      | "       | 3 13                | 02  | 8         | 1                  | 15W.                     | 21 6 | 20 8       | 24 1 | 24 1        | 0012     | "             | P |
| "                           | 986              | "       | "      | "       | 6 16                | 38  | 23        | 5                  | 15W.                     | 19 5 | 19 4       | 23 3 | 23 3        | 0012     | Poor....      | H |
| "                           | 1006             | "       | "      | "       | 12 16               | 36  | 12        | 5                  | 31W.                     | 23 0 | 22 5       | 29 0 | 29 0        | 0014     | Unst'dy       | H |
| "                           | 1014             | "       | "      | "       | 15 15               | 09  | 7         | 4                  | 20W.                     | 22 3 | 19 5       | 26 3 | 26 3        | 0014     | Very poor..   | H |
| "                           | 1017             | "       | "      | "       | 22 15               | 11  | 11        | 4                  | 47W.                     | 18 7 | 18 5       | 24 1 | 24 2        | 0014     | Fair....      | H |
| "                           | 1022             | "       | "      | "       | 23 14               | 46  | 62        | 4                  | 46W.                     | 22 5 | 21 4       | 27 0 | 27 0        | 0014     | Light clouds. | T |
| "                           | 1026             | "       | "      | "       | 27 12               | 06  | 13        | 2                  | 57W.                     | 18 5 | 18 5       | 20 6 | 20 6        | 0014     | Fair....      | H |
| "                           | 1032             | "       | "      | Sept.   | 6 13                | 43  | 17        | 4                  | 15W.                     | 19 0 | 18 5       | 21 0 | 21 0        | 0012     | Good....      | T |
| "                           | 1037             | "       | "      | "       | 12 14               | 39  | 18        | 5                  | 37W.                     | 17 0 | 16 8       | 20 9 | 20 9        | 0012     | "             | T |
| "                           | 1047             | "       | "      | "       | 18 12               | 50  | 30        | 4                  | 17W.                     | 15 0 | 15 0       | 17 1 | 17 1        | 0012     | Cloudy.       | T |
| "                           | 1048             | "       | "      | "       | 18 13               | 16  | 16        | 4                  | 36W.                     | 15 0 | 14 2       | 17 1 | 17 1        | 0012     | Fair....      | T |
| "                           | 1060             | "       | "      | "       | 20 13               | 35  | 20        | 5                  | 05W.                     | 22 0 | 22 0       | 22 9 | 22 9        | 0012     | Poor....      | H |
| "                           | 1061             | "       | "      | "       | 20 13               | 58  | 24        | 5                  | 30W.                     | 22 0 | 22 3       | 22 9 | 22 9        | 0012     | "             | H |
| "                           | 1083             | "       | "      | Oct.    | 1 13                | 44  | 16        | 5                  | 55W.                     | 10 5 | 10 4       | 14 2 | 14 2        | 0014     | "             | H |
| "                           | 1084             | "       | "      | "       | 1 14                | 06  | 27        | 6                  | 23W.                     | 10 4 | 10 2       | 14 2 | 14 1        | 0014     | Hazy....      | H |

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RECORD OF SPECTROGRAMS.—(Continued).

| STAR.           | No. of Negative. | Camera. | Plate.   | Date.      | Middle of Exposure. |       | Duration. | Hour Angle at end. | TEMPERATURE. Centigrade. |      |            |      | Slit Width. | Seeing.        | Observer. |
|-----------------|------------------|---------|----------|------------|---------------------|-------|-----------|--------------------|--------------------------|------|------------|------|-------------|----------------|-----------|
|                 |                  |         |          |            | G. M. T.            |       |           |                    | Room.                    |      | Prism Box. |      |             |                |           |
|                 |                  |         |          |            | h.                  | m.    |           |                    | Beg.                     | End. | Beg.       | End. |             |                |           |
| $\alpha$ Coronæ | 1393             | IL      | Seed 27  | 1908. Mar. | 9 22                | 08 24 | 55W.      | -15 0              | -15 0                    | 1 0  | 1 0        |      | Hazy        | H              |           |
| Borealis :      | 1402             | "       | "        | "          | 16 21               | 02 10 | 9W.       | -12 5              | -13 0                    | 2 3  | 2 3        |      | Good        | H              |           |
| "               | 1493             | "       | "        | Apr.       | 15 19               | 18 8  | 28W.      | -3 0               | -2 3                     | 7 8  | 7 7        |      | "           | P              |           |
| "               | 1565             | "       | Seed     | June       | 1 18                | 00 30 | 2 50W.    | 15 7               | 14 6                     | 21 4 | 21 3       |      | "           | P.             |           |
| "               | 1566             | "       | Process  | "          | "                   | "     | "         | "                  | "                        | "    | "          |      | "           | P <sub>1</sub> |           |
| "               | 1571             | "       | Seed 27. | "          | 1 18                | 42 15 | 3 13W.    | 14 5               | 14 0                     | 21 3 | 21 2       |      | Fair        | P <sub>1</sub> |           |
| "               | 1572             | "       | "        | "          | 3 16                | 32 15 | 57W.      | 14 9               | 15 0                     | 18 4 | 18 4       |      | "           | P              |           |
| "               | 1572             | "       | "        | "          | 3 16                | 52 15 | 1 20W.    | 15 0               | 14 8                     | 18 4 | 18 4       |      | "           | P              |           |
| "               | 1581             | "       | "        | "          | 5 17                | 31 18 | 2 04W.    | 17 5               | 17 0                     | 24 6 | 24 6       | 0016 | Good        | H              |           |
| "               | 1601             | "       | "        | "          | 12 16               | 56 12 | 1 54W.    | 19 5               | 19 6                     | 25 0 | 25 0       | 0017 | "           | H              |           |
| "               | 1608             | "       | "        | "          | 17 13               | 53 14 | 50E.      | 19 0               | 18 5                     | 23 4 | 23 3       | 0016 | "           | H              |           |
| "               | 1623             | "       | "        | "          | 22 16               | 27 14 | 2 10W.    | 18 3               | 18 0                     | 23 7 | 23 8       | 0015 | Fair        | P              |           |
| "               | 1624             | "       | "        | "          | 22 16               | 43 13 | 2 25W.    | 18 0               | 18 0                     | 23 8 | 23 8       | 0015 | Good        | P              |           |
| "               | 1628             | "       | "        | "          | 21 15               | 26 18 | 1 15W.    | 21 5               | 21 5                     | 27 5 | 27 5       | 0015 | "           | P              |           |
| "               | 1629             | "       | "        | "          | 24 15               | 49 15 | 1 35W.    | 21 5               | 21 5                     | 27 5 | 27 5       | 0015 | "           | P              |           |
| "               | 1638             | "       | "        | "          | 26 15               | 51 15 | 1 18W.    | 21 0               | 20 5                     | 30 0 | 30 0       | 0016 | "           | H              |           |
| "               | 1639             | "       | "        | "          | 26 16               | 04 8  | 1 57W.    | 20 5               | 21 0                     | 30 0 | 30 0       | 0016 | "           | H              |           |
| "               | 1646             | "       | "        | "          | 27 16               | 20 10 | 2 20W.    | 20 8               | 20 5                     | 23 8 | 23 8       | 0014 | "           | P              |           |
| "               | 1647             | "       | "        | "          | 27 16               | 30 10 | 2 30W.    | 20 5               | "                        | "    | "          | "    | Fair        | P              |           |
| "               | 1652             | "       | "        | July       | 1 15                | 15 30 | 1 30W.    | 23 6               | 23 6                     | 25 8 | 25 8       | 0015 | Cloudy      | P              |           |
| "               | 1656             | "       | "        | "          | 3 15                | 17 13 | 1 38W.    | 23 0               | 21 9                     | 25 5 | 25 5       | 001  | Good        | H              |           |
| "               | 1665             | "       | "        | "          | 6 16                | 50 10 | 3 20W.    | 24 0               | 23 8                     | 26 4 | 26 4       | 0015 | "           | P              |           |
| "               | 1674             | "       | "        | "          | 8 15                | 11 10 | 1 50W.    | 19 0               | 19 3                     | 21 8 | 21 8       | 0015 | Fair        | C              |           |
| "               | 1683             | "       | "        | "          | 10 13               | 34 20 | 2 26W.    | 25 0               | 24 5                     | 27 5 | 27 5       | 0012 | Good        | H              |           |
| "               | 1684             | "       | "        | "          | 10 13               | 51 13 | 4 40W.    | 24 5               | 24 5                     | 27 5 | 27 5       | 0012 | "           | H              |           |
| "               | 1692             | "       | "        | "          | 11 16               | 29 10 | 3 12W.    | 27 7               | 27 5                     | 30 1 | 30 1       | 0015 | Fair        | P              |           |
| "               | 1697             | "       | "        | "          | 13 15               | 26 13 | 2 25W.    | 20 0               | 19 9                     | 23 1 | 23 1       | 0015 | "           | P              |           |
| "               | 1698             | "       | "        | "          | 13 15               | 42 16 | 2 50W.    | 19 9               | 19 6                     | 23 1 | 23 1       | 0015 | "           | P              |           |
| "               | 1711             | "       | "        | "          | 15 16               | 24 12 | 3 30W.    | 17 5               | 17 0                     | 21 6 | 21 6       | 0015 | Good        | H              |           |
| "               | 1721             | "       | "        | "          | 24 13               | 05 15 | 4 48W.    | 24 0               | 24 0                     | 26 4 | 26 4       | 0012 | "           | H              |           |
| "               | 1722             | "       | "        | "          | 24 13               | 21 14 | 1 03W.    | 24 0               | 24 0                     | 26 4 | 26 4       | 0012 | "           | C              |           |
| "               | 1739             | "       | "        | "          | 29 15               | 34 12 | 3 37W.    | 26 6               | 26 3                     | 30 2 | 30 2       | 0015 | Fair        | P              |           |
| "               | 1748             | "       | "        | "          | 31 13               | 38 17 | 2 00W.    | 23 3               | 23 1                     | 26 0 | 26 0       | 0015 | "           | P <sub>1</sub> |           |
| "               | 1749             | "       | "        | "          | 31 14               | 00 20 | 2 20W.    | 23 0               | 22 6                     | 26 0 | 26 0       | 0015 | "           | P <sub>1</sub> |           |
| "               | 1764             | "       | "        | Aug.       | 5 15                | 37 15 | 4 10W.    | 22 0               | 21 6                     | 26 9 | 26 9       | 0015 | "           | P              |           |
| "               | 1773             | "       | "        | "          | 7 14                | 25 20 | 3 05W.    | 21 5               | 20 6                     | 23 6 | 23 6       | 0015 | Hazy        | P <sub>1</sub> |           |
| "               | 1775             | "       | "        | "          | 7 16                | 25 10 | 5 05W.    | 19 1               | 19 0                     | 23 6 | 23 6       | 0015 | Good        | P <sub>1</sub> |           |
| "               | 1797             | "       | "        | "          | 20 12               | 51 16 | 2 21W.    | 19 2               | 19 0                     | 23 1 | 23 1       | 0015 | Fair        | H              |           |
| "               | 1798             | "       | "        | "          | 20 13               | 05 10 | 2 32W.    | 19 0               | 18 8                     | 23 1 | 23 0       | 0015 | Good        | H              |           |
| "               | 1805             | "       | "        | "          | 21 12               | 54 11 | 2 22W.    | 21 1               | 20 6                     | 25 8 | 25 8       | 0015 | "           | C              |           |
| "               | 1809             | "       | "        | "          | 21 15               | 01 12 | 4 30W.    | 18 8               | 18 4                     | 25 0 | 25 4       | 0015 | "           | C              |           |
| "               | 1816             | "       | "        | "          | 24 13               | 17 15 | 3 03W.    | 18 5               | 18 2                     | 23 4 | 23 4       | 0015 | "           | H              |           |
| "               | 1817             | "       | "        | "          | 24 13               | 32 14 | 3 17W.    | 18 2               | 17 5                     | 23 4 | 23 3       | 0015 | "           | H              |           |
| "               | 1827             | "       | "        | "          | 25 13               | 00 14 | 2 49W.    | 20 6               | 19 3                     | 26 0 | 26 0       | 0015 | Hazy        | C              |           |
| "               | 1836             | "       | "        | "          | 27 14               | 34 12 | 4 30W.    | 18 3               | 18 0                     | 23 2 | 23 2       | 0015 | Good        | C              |           |
| "               | 1842             | "       | "        | "          | 28 13               | 14 12 | 3 16W.    | 18 5               | 18 2                     | 23 3 | 23 3       | 0015 | "           | C              |           |
| "               | 1852             | "       | "        | "          | 31 13               | 17 15 | 3 30W.    | 24 0               | 24 0                     | 28 0 | 28 0       | 0015 | "           | P              |           |
| "               | 1861             | "       | "        | Sept.      | 3 12                | 50 13 | 3 15W.    | 18 6               | 18 8                     | 21 2 | 21 1       | 0015 | "           | H              |           |
| "               | 1865             | "       | "        | "          | 4 13                | 27 26 | 4 05W.    | 20 5               | 20 3                     | 23 4 | 23 4       | 0015 | Poor        | P <sub>1</sub> |           |
| "               | 1882             | "       | "        | "          | 14 12               | 51 13 | 4 00W.    | 18 6               | 18 4                     | 21 7 | 21 7       | 0015 | Fair        | P              |           |
| "               | 1894             | "       | "        | "          | 19 12               | 02 13 | 3 30W.    | 17 5               | 17 3                     | 21 2 | 21 2       | 0015 | "           | P              |           |
| "               | 1895             | "       | "        | "          | 19 12               | 17 15 | 3 45W.    | 17 3               | 17 2                     | 21 2 | 21 2       | 0015 | "           | P              |           |
| "               | 1896             | "       | "        | "          | 19 12               | 32 15 | 4 00W.    | 17 2               | 16 8                     | 21 1 | 21 1       | 0015 | "           | P              |           |
| "               | 1897             | "       | "        | "          | 19 12               | 50 16 | 4 20W.    | 16 8               | 16 5                     | 21 1 | 21 0       | 0015 | "           | P              |           |
| "               | 1949             | "       | "        | Nov.       | 1 10                | 41 17 | 5 00W.    | 2 0                | 0 6                      | 3 8  | 3 8        | 0015 | Good        | C              |           |
| "               | 1991             | "       | "        | Dec.       | 2 10                | 10 10 | 6 19W.    | -7 5               | -8 2                     | -2 0 | -2 0       | 0015 | Windy       | C              |           |
| "               | 1992             | "       | "        | "          | 2 10                | 21 13 | 6 30W.    | -8 2               | -8 2                     | -2 0 | -2 0       | 0015 | "           | C              |           |

α CORONÆ BOREALIS, 784.

1907, May 24  
G. M. T. 17<sup>h</sup> 43<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 12  | 72.9951           | 4891.192              | .....                  | .....               | .....                        | .....     | 13  | 27.6301           | 4105.162              | .....                  | .....               | .....                        | .....     |
| 12  | 72.7321           | 4861.180              | 187                    | 527                 | 340                          | -21.00    | 1   | 27.3080           | 4101.318              | 440                    | 890                 | 450                          | -32.90    |
| 12  | 72.3165           | 4851.453              | .....                  | .....               | .....                        | .....     | 13  | 27.1825           | 4099.824              | .....                  | .....               | .....                        | .....     |
| 12  | 47.6461           | 4379.418              | .....                  | .....               | .....                        | .....     | 2   | 15.4180           | 3969.627              | 807                    | 177                 | 670                          | -50.77    |
| 12  | 45.0940           | 4340.085              | 054                    | 634                 | 580                          | -40.02    | 2   | 15.3605           | 3969.034              | .....                  | .....               | .....                        | .....     |
| 12  | 44.1555           | 4323.981              | .....                  | .....               | .....                        | .....     | 3   | 28.1875           | 4111.853              | .....                  | .....               | .....                        | .....     |

Weighted mean..... -32.78  
 $V_a$ ..... -7.63  
 $V_d$ ..... .07  
 Curvature..... .28  
 Radial velocity..... -39.8

α CORONÆ BOREALIS, 790.

1907, May 29  
G. M. T. 15<sup>h</sup> 14<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 12  | 73.2093           | 4870.229              | .....                  | .....               | .....                        | .....     | 2     | 27.7347           | 4105.312              | .....                  | .....               | .....                        | .....     |
| 12  | 72.8135           | 4800.908              | 2.107                  | 1.527               | 580                          | +35.78    | 13    | 27.5259           | 4102.815              | 700                    | 1.890               | 810                          | +59.21    |
| 12  | 63.6051           | 4661.138              | .....                  | .....               | .....                        | .....     | 3     | 27.2873           | 4099.970              | .....                  | .....               | .....                        | .....     |
| 3   | 48.7335           | 4395.316              | .....                  | .....               | .....                        | .....     | 13    | 15.64—            | 3970.820              | 797                    | 177                 | 620                          | +47.00    |
| 1   | 45.2535           | 4341.252              | .....                  | .....               | .....                        | .....     | 3     | 15.4860           | 3969.232              | .....                  | .....               | .....                        | .....     |
| 2   | 45.2502           | 4341.201              | 114                    | 0.634               | 480                          | +33.12    | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean..... +41.68  
 $V_a$ ..... -9.22  
 $V_d$ ..... +.10  
 Curvature..... .28  
 Radial velocity..... +32.3

SESSIONAL PAPER No. 25a

α CORONÆ BOREALIS, 794.

1907, May 29,  
G. M. T. 18<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1   | 72·8775           | 4862·407              | 407                    | 1·527               | 880                          | +59·30    | 1     | 27·5506           | 4102·369              | 360                    | 1·890               | 470                          | +34·36    |
| 2   | 63·6559           | 4661·600              | 388                    | 0·634               | 754                          | +52·02    | 2     | 12·111            | 3934·713              | 795                    | 3·825               | 970                          | +74·01    |
| 3   | 45·3234           | 4341·403              | .....                  | .....               | .....                        | .....     | 3     | 11·6613           | 3930·276              | .....                  | .....               | .....                        | .....     |
| 1   | 45·3085           | 4341·177              | .....                  | .....               | .....                        | .....     | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |
| 1   | 27·7905           | 4105·235              | .....                  | .....               | .....                        | .....     | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean..... +53·45  
 $V_a$ ..... = 9·22  
 $V_d$ ..... = 14  
 Curvature..... = 28  
 Radial velocity..... +43·8

α CORONÆ BOREALIS, 890.

1907, May 31,  
G. M. T. 17<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1   | 73·2965           | 4871·490              | .....                  | .....               | .....                        | .....     | 1     | 45·3314           | 4341·634              | 1000                   | 0·634               | 366                          | +25·25    |
| 1   | 72·8966           | 4862·058              | 2·021                  | 1·527               | 494                          | +30·48    | 2     | 45·3203           | 4341·463              | .....                  | .....               | .....                        | .....     |
| 1   | 63·6950           | 4662·143              | .....                  | .....               | .....                        | .....     | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean..... +28·24  
 $V_a$ ..... = 9·87  
 $V_d$ ..... = 09  
 Curvature..... = 28  
 Radial velocity..... +18·00

α CORONÆ BOREALIS, 890<sup>a</sup>.

1907. May 31.  
G. M. T. 17<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 73 1662           | 4870 711              | .....                  | .....               | .....                        | .....     | 1   | 53 9228           | 4482 746              | 156                    | 400                 | 756                          | +50.57    |
| 2   | 72 7643           | 4861 253              | 993                    | 527                 | 366                          | -22 58    | 1   | 45 1975           | 4341 903              | .....                  | .....               | .....                        | .....     |
| 1   | 53 9370           | 4482 990              | .....                  | .....               | .....                        | .....     | 2   | 45 1921           | 4341 822              | 084                    | 634                 | 450                          | +31.05    |

Weighted mean ..... +26.82

$V_a$  ..... - 9.87

$V_d$  ..... - .09

Curvature..... - .28

Radial velocity..... +16.6

<sup>a</sup>Check measurement.

α CORONÆ BOREALIS, 898.

1907. June 8.  
G. M. T. 16<sup>h</sup> 28<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 73 6301           | 4880 622              | .....                  | .....               | .....                        | .....     | 14  | 53 2825           | 4459 560              | .....                  | .....               | .....                        | .....     |
| 14  | 73 2099           | 4870 635              | .....                  | .....               | .....                        | .....     | 14  | 45 2977           | 4341 349              | .....                  | .....               | .....                        | .....     |
| 2   | 72 7779           | 4860 446              | 117                    | 527                 | 410                          | -25 30    | 1   | 45 2356           | 4340 398              | 224                    | 634                 | 410                          | -28 29    |
| 14  | 54 7247           | 4494 835              | .....                  | .....               | .....                        | .....     | 2   | 27 4985           | 4101 465              | 740                    | 890                 | 150                          | -10 97    |
| 1   | 53 9597           | 4481 558              | 400                    | 400                 | 000                          | [0 00]    | 2   | 27 3464           | 4099 648              | .....                  | .....               | .....                        | .....     |

Weighted mean ..... - 24 63

$V_a$  ..... - 12 26

$V_d$  ..... - .07

Curvature ..... - .28

Radial velocity ..... - 37 2

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α CORONÆ BOREALIS, 813.

1907, June 10,  
G. M. T. 15<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 1   | 72.9500           | 4864.729              | .....                  | .....               | .....                        | .....     | 1   | 45.2570           | 4340.581              | 584                    | 634                 | 050                          | - 3.45    |
| 1   | 72.7916           | 4860.995              | .047                   | .527                | .480                         | -29.62    | 1   | 27.4836           | 4101.565              | 565                    | 890                 | 325                          | -23.76    |
| 1   | 54.0328           | 4482.605              | .....                  | .....               | .....                        | .....     | 1   | 11.9745           | 3933.225              | 505                    | 825                 | 320                          | -23.52    |
| 1   | 53.9933           | 4481.933              | .720                   | .400                | .320                         | + (21.40) | 3   | 11.6547           | 3930.972              | .....                  | .....               | .....                        | .....     |

Weighted mean ..... - 19.99  
 $V_a$  ..... - 12.82  
 $V_d$  ..... .00  
 Curvature ..... - .28  
 Radial velocity ..... - 33.1

α CORONÆ BOREALIS, 813<sup>a</sup>.

1907, June 10,  
G. M. T. 15<sup>h</sup> 23<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 1   | 73.0019           | .....                    | .....                        | .....     | 1     | 27.4611           | .3746                    | .0380                        | - 33.00   |
| 1   | 72.8452           | .843                     | .0105                        | - 15.23   | 1     | 27.3334           | .....                    | .....                        | .....     |
| 1   | 72.4360           | .....                    | .....                        | .....     | 1     | 11.9831           | .8494                    | .0020                        | - 1.50    |
| 1   | 45.2832           | .....                    | .....                        | .....     | 1     | 11.6415           | .....                    | .....                        | .....     |
| 1   | 45.2550           | 2404                     | .0017                        | + 1.77    | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... - 11.33  
 $V_a$  ..... - 12.82  
 $V_d$  ..... .00  
 Curvature ..... - .28  
 Radial velocity ..... - 23.4

Check measurement.

9-10 EDWARD VII., A. 1910

α CORONÆ BOREALIS, 830.

1907, June 11.  
G. M. T. 17<sup>h</sup> 40<sup>m</sup>

Observed by | W. E. HARPER.  
Measured by |

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0400           |                          |                              |           | 1   | 27 5388           | 4018                     | 0108                         | - 9 37    |
| 2   | 72 9065           | 8714                     | 0666                         | - 9 57    | 2   | 27 3838           |                          |                              |           |
| 2   | 72 4707           |                          |                              |           | 2   | 15 6378           | 4462                     | 0271                         | -20 97    |
| 2   | 45 3505           |                          |                              |           | 2   | 15 5903           |                          |                              |           |
| 1½  | 45 2971           | 2202                     | 0177                         | - 19 31   |     |                   |                          |                              |           |

Weighted mean ..... -12 59  
 $V_a$  ..... -13 12  
 $V_d$  ..... - 14  
 Curvature ..... - 28  
 Radial velocity ..... - 26 1

α CORONÆ BOREALIS, 837 (α).

1907, June 12.  
G. M. T. 17<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 73 2575           | 4871 377              |                        |                     |                              |           | 1½  | 53 2836           | 4469 109              | 260                    | 1 400               | 140                          | - 9 37    |
| 2   | 72 9550           | 4864 316              |                        |                     |                              |           | 2   | 45 2743           | 4341 034              |                        |                     |                              |           |
| 1   | 72 7939           | 4860 427              | 027                    | 527                 | 500                          | - 30 85   | 2   | 45 2468           | 4340 618              | 744                    | 634                 | 110                          | + 7 59    |
| 1½  | 54 7243           | 4494 565              |                        |                     |                              |           | 1   | 27 4500           | 4101 723              | 700                    | 890                 | 190                          | -13 40    |
| 1   | 54 0416           | 4482 729              | 880                    | 1 400               | 1480                         | + [09 01] | 2   | 27 2997           | 4099 937              |                        |                     |                              |           |
| 1½  | 53 9476           | 4484 109              |                        |                     |                              |           |     |                   |                       |                        |                     |                              |           |

Weighted mean ..... - 7 84  
 $V_a$  ..... -13 39  
 $V_d$  ..... - 15  
 Curvature ..... - 28  
 Radial velocity ..... - 21 7



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$\alpha$  CORONÆ BOREALIS, 837 (b).

1907. June 12.  
G. M. T. 17<sup>h</sup> 48<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.              | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. |
|------------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 13               | 73.3641           | 4871.496              | .....                  | .....               | .....                        | .....     | 1 $\frac{1}{2}$ | 45.3637           | 4340.923              | 7831                   | 631                 | 200                          | +13.80    |
| 13 $\frac{1}{2}$ | 73.0748           | 4864.652              | .....                  | .....               | .....                        | .....     | 1               | 27.5769           | 4102.126              | 780                    | 890                 | 110                          | - 8.74    |
| 1                | 72.9262           | 4861.152              | 417                    | 527                 | 080                          | - 4.90    | 2               | 27.4205           | 4100.265              | .....                  | .....               | .....                        | .....     |
| 12               | 45.3955           | 4341.251              | .....                  | .....               | .....                        | .....     | .....           | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean ..... + 3.22  
 $V_a$  ..... -13.39  
 $V_d$  ..... .15  
 Curvature ..... .23  
 Radial velocity ..... - 11.6

$\alpha$  CORONÆ BOREALIS, 845.

1907. June 13.  
G. M. T. 16<sup>h</sup> 32<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.              | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt.   | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|------------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 13               | 73.5911           | 4875.434              | .....                  | .....               | .....                        | .....     | 3     | 30.3756           | 4135.609              | 374                    | .....               | .....                        | .....     |
| 13 $\frac{1}{2}$ | 73.1412           | 4864.776              | .....                  | .....               | .....                        | .....     | 3     | 30.3142           | 4134.852              | .....                  | .....               | .....                        | .....     |
| 1                | 73.0219           | 4861.964              | 817                    | 527                 | 290                          | +17.89    | 1     | 27.6096           | 4102.126              | 1.921                  | 890                 | 631                          | + 2.27    |
| 12               | 45.4418           | 4341.360              | .....                  | .....               | .....                        | .....     | 2     | 27.4418           | 4100.132              | .....                  | .....               | .....                        | .....     |
| 12 $\frac{1}{2}$ | 45.4224           | 4341.068              | 0.862                  | 634                 | 23.4                         | +16.14    | ..... | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean ..... +12.68  
 $V_a$  ..... -13.65  
 $V_d$  ..... .10  
 Curvature ..... .23  
 Radial velocity ..... - 1.4

9-10 EDWARD VII., A. 1910

α CORONÆ BOREALIS, 850 (a).

1907, June 14.  
G. M. T. 16<sup>h</sup> 39<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 2   | 73.4113           | 4875.633              | .....                  | .....               | .....                        | .....     | 11  | 53.9875           | 4482.586              | 1.046                  | .400                | .646                         | + [43.22] |
| 2   | 72.9635           | 4865.637              | .....                  | .....               | .....                        | .....     | 11  | 53.2781           | 4470.405              | .....                  | .....               | .....                        | .....     |
| 1   | 72.8279           | 4861.845              | .....                  | .....               | .....                        | .....     | 12  | 45.2668           | 4341.590              | .....                  | .....               | .....                        | .....     |
| 11  | 54.3973           | 4489.656              | .747                   | .527                | .220                         | +13.57    | 12  | 45.2482           | 4341.307              | 0.879                  | .634                | .245                         | +16.90    |

Weighted mean ..... +15.79  
*V<sub>a</sub>* ..... -13.92  
*V<sub>d</sub>* ..... .12  
 Curvature ..... .28

Radial velocity ..... +1.5

α CORONÆ BOREALIS, 850 (b).

1907, June 14.  
G. M. T. 16<sup>h</sup> 52<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. | Wt. | Mean of Settings. | Computed Wave Length. | Corrected wave length. | Normal wave length. | Displacement in revolutions. | Velocity. |
|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
| 14  | 73.4199           | 4875.835              | .....                  | .....               | .....                        | .....     | 2   | 45.2684           | 4341.613              | .188                   | .634                | .554                         | +38.23    |
| 13  | 72.9631           | 4865.169              | .....                  | .....               | .....                        | .....     | 1   | 27.4757           | 4102.322              | 2.290                  | 1.890               | .400                         | +29.24    |
| 1   | 72.8446           | 4862.238              | 1.997                  | .527                | .470                         | +29.00    | 2   | 27.2770           | 4099.954              | .....                  | .....               | .....                        | .....     |
| 2   | 45.2666           | 4341.587              | .....                  | .....               | .....                        | .....     |     |                   |                       |                        |                     |                              |           |

Weighted mean ..... +33.68  
*V<sub>a</sub>* ..... -13.92  
*V<sub>d</sub>* ..... .12  
 Curvature ..... .28

Radial velocity ..... +19.4

SESSIONAL PAPER No. 25a :

$\alpha$  CORONÆ BOREALIS, 861 (*a*).

1907. June 20,  
G. M. T. 16<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. | Wt.             | Mean of Settings. | Computed Wave Length. | Corrected Wave Length. | Normal Wave Length. | Displacement in revolutions. | Velocity. |
|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|-----------------|-------------------|-----------------------|------------------------|---------------------|------------------------------|-----------|
|                 | 1                 | 73 2760               | 4871 450               | .....               | .....                        | .....     |                 | .....             | 1 $\frac{1}{2}$       | 45 2526                | 4341 493            | .....                        | .....     |
| 1 $\frac{1}{2}$ | 72 9905           | 4864 720              | .....                  | .....               | .....                        | .....     | 1 $\frac{1}{2}$ | 45 2364           | 4341 249              | 0 918                  | 0 634               | 284                          | +19 60    |
| 1               | 72 8861           | 4862 267              | 2 467                  | 1 527               | 940                          | +58 00    | 1               | 27 4436           | 4102 363              | 2 320                  | 1 890               | 430                          | +31 43    |
| 54              | 0070              | 4482 788              | 2 495                  | 1 400               | 1 095                        | + [73.25] | 1 $\frac{1}{2}$ | 27 2416           | 4099 960              | .....                  | .....               | .....                        | .....     |
| 53              | 2695              | 4470 164              | .....                  | .....               | .....                        | .....     | .....           | .....             | .....                 | .....                  | .....               | .....                        | .....     |

Weighted mean..... + 33.95  
 $V_a$ ..... - 15.42  
 $V_d$ ..... - 11  
 Curvature..... - 28  
 Radial velocity..... + 17.1

$\alpha$  CORONÆ BOREALIS, 869 (*a*).

1907. June 21,  
G. M. T. 15<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
|                 | 2                 | 73 4538                  | .....                        | .....     |       | .....             | 1                        | 53 1220                      | .....     |
| 1 $\frac{1}{2}$ | 72 9987           | .....                    | .....                        | .....     | 2     | 45 2828           | .....                    | .....                        | .....     |
| 1               | 72 8723           | 8833                     | 0185                         | +26 84    | 2     | 45 2626           | 2574                     | 0187                         | +19 52    |
| 1               | 72 4343           | .....                    | .....                        | .....     | 1     | 27 4687           | 4329                     | 0203                         | +17 62    |
| 1 $\frac{1}{2}$ | 54 7447           | .....                    | .....                        | .....     | 2     | 27 2824           | .....                    | .....                        | .....     |
| 54              | 0017              | 9962                     | 0264                         | + [30 39] | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean..... + 20.88  
 $V_a$ ..... - 15.65  
 $V_d$ ..... - 05  
 Curvature..... - 28  
 Radial velocity..... + 4.9

9-10 EDWARD VII., A. 1910

$\alpha$  CORONÆ BOREALIS, 869 (b).

1907. June 21.  
G. M. T. 15<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 4265           | .....                    | .....                        | .....     | 1½  | 53 0887           | .....                    | .....                        | .....     |
| 1   | 72 9753           | .....                    | .....                        | .....     | 2   | 45 2563           | .....                    | .....                        | .....     |
| 1   | 72 8572           | 8940                     | 0292                         | + 42 37   | 2   | 45 2497           | 2670                     | 0283                         | + 29 53   |
| 1   | 72 4075           | .....                    | .....                        | .....     | 2   | 27 4248           | 4145                     | 0019                         | + 1 65    |
| 1   | 54 7245           | .....                    | .....                        | .....     | 2   | 27 2569           | .....                    | .....                        | .....     |
| 1   | 54 0067           | 0197                     | 0499                         | + [57 42] |     |                   |                          |                              |           |

Weighted mean..... + 29 22  
 $V_a$ ..... - 15 66  
 $V_d$ ..... - 07  
 Curvature..... - 28

Radial velocity..... + 13 2

$\alpha$  CORONÆ BOREALIS, 880.

1907. June 25.  
G. M. T. 15<sup>h</sup> 43<sup>m</sup>

Observed by )  
Measured by ) W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 49 3450           | .....                    | .....                        | .....     | ½   | 27 4294           | 4144                     | 0018                         | + 1 50    |
| 2   | 45 1892           | 2092                     | 0295                         | - 30 80   | 1½  | 27 2616           | .....                    | .....                        | .....     |
| 2   | 44 2398           | .....                    | .....                        | .....     |     |                   |                          |                              |           |

Weighted mean..... - 24 34  
 $V_a$ ..... - 16 56  
 $V_d$ ..... - 10  
 Curvature..... - 28

Radial velocity..... - 41 3

SESSIONAL PAPER No. 25a

$\alpha$  CORONÆ BOREALIS, 888.

1907. June 26.  
G. M. T. 15<sup>h</sup> 01<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 48.7894           |                          |                              |           | 1   | 27.5130           | 5633                     | 0168                         | +13.57    |
| 2   | 45.2958           | 2794                     | 0307                         | -32.14    | 1   | 27.3316           |                          |                              |           |
| 2   | 45.2880           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean . . . . . -28.42  
 $V_a$  . . . . . -18.76  
 $V_d$  . . . . . - .05  
 Curvature . . . . . - .28  
 Radial velocity . . . . . +11.3

$\alpha$  CORONÆ BOREALIS, 892 (a).

1907. June 27.  
G. M. T. 15<sup>h</sup> 25<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.9825           |                          |                              |           | 2     | 45.2750           |                          |                              |           |
| 1   | 72.8545           | 8822                     | 0174                         | +25.20    | 1     | 45.2277           | 2363                     | 0124                         | -12.98    |
| 2   | 72.4160           |                          |                              |           | 2     | 57.8430           | 8237                     | 0190                         | +(22.91)* |
| 1/2 | 54.0205           |                          |                              |           | 1 1/2 | 57.8172           |                          |                              |           |
| 4   | 53.9655           | 9603                     | 0037                         | + [4.27]  |       |                   |                          |                              |           |

Weighted mean . . . . . +12.47  
 $V_a$  . . . . . -16.98  
 $V_d$  . . . . . - .09  
 Curvature . . . . . - .28  
 Radial velocity . . . . . - 4.9

\*Not used.

$\alpha$  CORONÆ BOREALIS, 892 (*b*).

1907. June 27.  
G. M. T. 15<sup>h</sup> 25<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0205           |                          |                              |           | 2   | 54.7740           |                          |                              |           |
| $\frac{1}{2}$ | 72.8582           | 8479                     | 0169                         | -24.52    | 1   | 54.0162           | 9814                     | 0116                         | + [13.35] |
| 2             | 72.4540           |                          |                              |           | 2   | 53.1495           |                          |                              |           |
| 2             | 57.8550           |                          |                              |           | 2   | 45.3208           |                          |                              |           |
| $\frac{1}{2}$ | 57.8570           | 8288                     | 0020                         | + (2.41)* | 1   | 45.2668           | 2196                     | 0191                         | - 19.94   |

Weighted mean ..... - 21.47  
 $V_a$  ..... - 16.98  
 $V_d$  ..... - .69  
 Curvature ..... - .28  
 Radial velocity ..... - 38.8

\*Not used.

$\alpha$  CORONÆ BOREALIS, 912 (*a*).

1907. July 4.  
G. M. T. 15<sup>h</sup> 38<sup>m</sup>

Observed by } W. E. HARPER.  
 Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.4621           |                          |                              |           | 3               | 54.0285           | 0243                     | 0545                         | + [62.73] |
| 1             | 73.0125           |                          |                              |           | 2               | 53.1130           |                          |                              |           |
| $\frac{1}{2}$ | 72.8823           | 8823                     | 0175                         | - 25.39   | 2               | 45.2818           |                          |                              |           |
| $\frac{1}{2}$ | 72.4506           |                          |                              |           | 1 $\frac{1}{2}$ | 45.2930           | 2848                     | 0461                         | + 48.13   |
| $\frac{1}{2}$ | 54.7496           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean ..... + 43.58  
 $V_a$  ..... - 18.30  
 $V_d$  ..... - .14  
 Curvature ..... - .28  
 Radial velocity ..... - 24.5

SESSIONAL PAPER No. 25a

*α* CORONÆ BOREALIS, 917 (*α*).

1907, July 5,  
G. M. T. 15<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72·9847           | .....                    | .....                        | .....     | 2   | 53·1159           | .....                    | .....                        | .....     |
| 1   | 72·8795           | ·9010                    | ·0392                        | + 56·38   | 2   | 45·2826           | .....                    | .....                        | .....     |
| 1½  | 72·4219           | .....                    | .....                        | .....     | 2   | 45·2955           | ·2865                    | ·0478                        | + 49·90   |
| 2   | 54·7410           | .....                    | .....                        | .....     | ½   | 27·4935           | ·4160                    | ·0334                        | + 28·99   |
| ¼   | 54·022            | ·0210                    | ·0512                        | + [58·93] | 2   | 27·2942           | .....                    | .....                        | .....     |

Weighted mean ..... +48·77  
*V<sub>a</sub>* ..... - 18·45  
*V<sub>d</sub>* ..... - ·10  
 Curvature ..... - ·28

Radial velocity ..... +29·9

*α* CORONÆ BOREALIS, 919.

1907, July 8,  
G. M. T. 15<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72·9772           | .....                    | .....                        | .....     | 1½  | 45·2712           | ·2697                    | ·0210                        | + 21·98   |
| 1   | 72·8492           | ·8372                    | ·0185                        | + 26·88   | 1   | 27·5298           | ·5265                    | ·0300                        | + 34·16   |
| 2   | 72·4058           | .....                    | .....                        | .....     | 1   | 30·9330           | .....                    | .....                        | .....     |
| 2   | 45·2852           | .....                    | .....                        | .....     | 2   | 27·3256           | .....                    | .....                        | .....     |

Weighted mean ..... + 26·86  
*V<sub>a</sub>* ..... - 18·95  
*V<sub>d</sub>* ..... - ·14  
 Curvature ..... - ·28

Radial velocity ..... + 7·5

9-10 EDWARD VII., A. 1910

 $\alpha$  CORONÆ BOREALIS, 927.1907, July 9.  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.  |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|------------|
| 2   | 72 9662           |                          |                              |           | 2   | 45 2862           |                          |                              |            |
| 1   | 72 8618           | 8562                     | 0375                         | -54 48    | 1½  | 45 2380           | 2354                     | 0133                         | -13 92     |
| 2   | 72 4106           |                          |                              |           | 2   | 27 4734           | 4889                     | 0076                         | + 1 40     |
| 2   | 54 7306           |                          |                              |           | 2   | 27 3064           |                          |                              |            |
| 1   | 53 9888           | 9833                     | 0207                         | + [30 81] | ½   | 57 8628           | 8428                     | 0428                         | + (51 62)* |
| 2   | 53 1078           |                          |                              |           | 2   | 57 8178           |                          |                              |            |

Weighted mean..... - 11 43  
 $V_a$ ..... - 19 09  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... - 8 0

\*Not used.

 $\alpha$  CORONÆ BOREALIS, 927.\*\*1907, July 9.  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.  | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|------------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9680           |                          |                              |            | 1   | 53 9622           | 9697                     | 0131                         | + [15 12] |
| 1   | 72 8569           | 8503                     | 0316                         | + 45 91    | 1½  | 53 0917           |                          |                              |           |
| 1½  | 72 4102           |                          |                              |            | 2   | 45 2603           |                          |                              |           |
| 1½  | 57 8736           | 8675                     | 0675                         | - (81 27)* | 1½  | 45 2267           | 2500                     | 0013                         | + 1 36    |
| 1½  | 57 8040           |                          |                              |            | ½   | 27 4465           | 4910                     | 0055                         | + 3 20    |
| 2   | 54 7205           |                          |                              |            | 3   | 27 2774           |                          |                              |           |

Weighted mean..... - 16 52  
 $V_a$ ..... - 19 09  
 $V_d$ ..... - 08  
 Curvature..... - 28

Radial velocity..... - 2 9

\*\*Check measurement.

\*Not used.



SESSIONAL PAPER No. 25a

$\alpha$  CORONÆ BOREALIS, 936.

1907, July 10.  
G. M. T. 14<sup>h</sup> 06<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 4385           |                          |                              |           | 2   | 45 3045           | 2916                     | } mean .0317                 | + 33 18   |
| 2   | 72 9873           |                          |                              |           | 2   | 45 2722           | 2693                     |                              |           |
| 1   | 72 8610           | 8370                     | 0183                         | + 26 58   | 1   | 27 4901           | 5206                     | 0241                         | + 28 99   |
| 2   | 45 2865           |                          |                              |           | 2   | 27 2917           |                          |                              |           |

Weighted mean..... + 30 48  
 $V_a$ ..... 19 23  
 $V_d$ ..... 05  
 Curvature..... 28

Radial velocity..... + 10.9

$\alpha$  CORONÆ BOREALIS, 936\*

1907, July 10.  
G. M. T. 14<sup>h</sup> 06<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0197           |                          |                              |           | $\frac{1}{2}$ | 27 5361           | 4419                     | 0293                         | + 25 43   |
| $\frac{1}{2}$ | 72 8963           | 8854                     | 0206                         | + 29 89   | $\frac{1}{2}$ | 27 3413           |                          |                              |           |
| 2             | 72 4588           |                          |                              |           | 2             | 12 0294           | 9169                     | 0655                         | + 49 06   |
| 2             | 45 3296           |                          |                              |           | 2             | 11 6198           |                          |                              |           |
| 1             | 45 3064           | 2504                     | 0117                         | + 12 21   |               |                   |                          |                              |           |

Weighted mean..... + 25 76  
 $V_a$ ..... 19 23  
 $V_d$ ..... 05  
 Curvature..... 28

Radial velocity..... + 6.2

\*Check measurement.

$\alpha$  CORONÆ BOREALIS, 939 (a).

1907, July 12.  
G. M. T. 16<sup>h</sup> 25<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9412           |                          |                              |           | $1\frac{1}{2}$ | 45 2344           | 2304                     | 0183                         | - 19 16   |
| 1   | 72 7980           | 8200                     | 0013                         | + 1 89    | 1              | 27 4394           | 4837                     | 0035                         | - 3 16    |
| 2   | 72 3774           |                          |                              |           | 2              | 27 2776           |                          |                              |           |
| 2   | 45 2876           |                          |                              |           |                |                   |                          |                              |           |

Weighted mean..... - 8 58  
 $V_a$ ..... 19 52  
 $V_d$ ..... 23  
 Curvature..... 28

Radial velocity..... - 28.6

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$\alpha$  CORONÆ BOREALIS, 941 (*a*).

1907 July 13.  
G. M. T. 15<sup>h</sup> 25<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9571           |                          |                              |           | 1   | 53 9164           | 9216                     | 00350                        | -[36 57]  |
| 1   | 72 7891           | 7967                     | 0220                         | -31 94    | 2   | 45 2737           |                          |                              |           |
| 2   | 72 3883           |                          |                              |           | 2   | 45 2395           | 2494                     | 00010                        | + 1 05    |
| 1   | 54 0101           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... - 9 95  
 $V_a$ ..... - 19 64  
 $V_d$ ..... - 20  
 Curvature..... - 28  
 Radial velocity..... - 30.1

$\alpha$  CORONÆ BOREALIS, 944 (*a*).

1907. July 16.  
G. M. T. 14<sup>h</sup> 37<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 72 9844           |                          |                              |           | 2             | 45 2506           | 2292                     | 0095                         | - 9 94    |
| 1              | 72 8686           | 8938                     | 0290                         | +42 08    | $\frac{1}{4}$ | 27 4712           | 4048                     | 0078                         | - 6 57    |
| $1\frac{1}{2}$ | 72 4200           |                          |                              |           | 2             | 27 3130           |                          |                              |           |
| 2              | 45 2950           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean..... - 20  
 $V_a$ ..... - 19 98  
 $V_d$ ..... - 11  
 Curvature..... - 28  
 Radial velocity..... - 20 6

$\alpha$  CORONÆ BOREALIS, 944 (*a*)\*.

1907. July 16.  
G. M. T. 14<sup>h</sup> 37<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 6086           |                          |                              |           | 2             | 53 1311           |                          |                              |           |
| $\frac{1}{4}$ | 72 8748           | 8752                     | 0104                         | +15 09    | 2             | 45 3033           |                          |                              |           |
| 2             | 72 4466           |                          |                              |           | 1             | 45 2588           | 2290                     | 0097                         | -10 12    |
| 2             | 54 7631           |                          |                              |           | $\frac{1}{2}$ | 27 5206           | 4520                     | 0394                         | +54 20    |
| $\frac{1}{4}$ | 54 0116           | 9915                     | 0217                         | + [21 98] | 2             | 27 3153           |                          |                              |           |

Weighted mean..... + 7 26  
 $V_a$ ..... - 19 98  
 $V_d$ ..... - 11  
 Curvature..... - 28

\*Check measurement.

Radial velocity..... - 13 1

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$\alpha$  CORONÆ BOREALIS, 951 (a).

1907, July 18,  
G. M. T. 14<sup>h</sup> 50<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0275           |                          |                              |           | 1   | 53.9282           | 0274                     | 0056                         | + [66.50] |
| 2   | 72.8907           | 8738                     | 0090                         | - 13.96   | 2   | 53.0075           |                          |                              |           |
| 2   | 72.4593           |                          |                              |           | 2   | 45.1272           |                          |                              |           |
| 2   | 54.6480           |                          |                              |           | 1   | 45.0922           | 2386                     | 0001                         | - 18.0    |

Weighted mean..... + 2.53  
 $V_a$ ..... - 20.16  
 $V_d$ ..... - 14  
 Curvature..... - .28  
 Radial velocity..... - 18.0

$\alpha$  CORONÆ BOREALIS, 951 (b).

1907, July 18,  
G. M. T. 15<sup>h</sup>

Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0220           |                          |                              |           | 1   | 53.8272           | 0264                     | 0264                         | - [30.38] |
| 2   | 72.8730           | 8616                     | 0032                         | - 1.64    | 2   | 52.9927           |                          |                              |           |
| 2   | 72.4539           |                          |                              |           | 2   | 45.1147           |                          |                              |           |
| 2   | 54.6277           |                          |                              |           | 1   | 45.0804           | 2395                     | 0008                         | + 8.35    |

Weighted mean..... - 0.31  
 $V_a$ ..... - 20.16  
 $V_d$ ..... - 14  
 Curvature..... - .28  
 Radial velocity..... - 20.9

$\alpha$  CORONÆ BOREALIS, 956 (a).

1907, July 20,  
G. M. T. 16<sup>h</sup> 07<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9731           |                          |                              |           | 2   | 45.3021           | 2932                     | 0445                         | + 46.59   |
| 1   | 72.8743           | 8653                     | 0418                         | + 65.09   | 1   | 27.5473           | 5493                     | 0621                         | + 54.03   |
| 1   | 72.4128           |                          |                              |           | 3   | 27.3199           |                          |                              |           |
| 2   | 45.2925           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... + 53.08  
 $V_a$ ..... - 20.37  
 $V_d$ ..... - 22  
 Curvature..... - .28  
 Radial velocity..... + 32.2

$\alpha$  CORONÆ BOREALIS, 963 (*a*).

1907, July 23,  
G. M. T. 14<sup>h</sup> 32<sup>m</sup>

Observed by J. N. TRIBBLE,  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 73 4670           |                          |                              |           | $\frac{1}{2}$ | 54 0566           | 0256                     | 0558                         | [+ 64 22] |
| 1             | 72 8900           | 8860                     | 0212                         | - 30 76   | 2             | 50 0472           |                          |                              |           |
| 2             | 76 6944           |                          |                              |           |               |                   |                          |                              |           |

|                 |         |
|-----------------|---------|
| $V_s$ .....     | + 30 76 |
| $V_a$ .....     | - 20 59 |
| $V_d$ .....     | - 14    |
| Curvature ..... | - 28    |

|                       |       |
|-----------------------|-------|
| Radial velocity ..... | + 9 8 |
|-----------------------|-------|

$\alpha$  CORONÆ BOREALIS, 973 (*a*).

1907, Aug. 1,  
G. M. T. 14<sup>h</sup> 06<sup>m</sup>

Observed by W. E. HARPER,  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Lines. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Lines. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|-----------------------|------------------------------|-----------|-----|-------------------|-----------------------|------------------------------|-----------|
| 2             | 72 9868           |                       |                              |           | 2   | 45 2780           |                       |                              |           |
| $\frac{1}{2}$ | 72 8440           | 8210                  | 0023                         | - 3 34    | 1   | 45 2568           | 2624                  | 0137                         | + 14 34   |
| 2             | 72 4220           |                       |                              |           |     |                   |                       |                              |           |

|                     |         |
|---------------------|---------|
| Weighted mean ..... | + 10 67 |
| $V_a$ .....         | - 20 98 |
| $V_d$ .....         | - 14    |
| Curvature .....     | - 28    |

|                       |        |
|-----------------------|--------|
| Radial velocity ..... | - 10 7 |
|-----------------------|--------|

$\alpha$  CORONÆ BOREALIS, 973 (*a*)<sup>4</sup>.

1907, Aug. 1,  
G. M. T. 14<sup>h</sup> 06<sup>m</sup>

Observed by W. E. HARPER,  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0688           |                          |                              |           | $\frac{1}{2}$ | 53 9750           | 9619                     | 0079                         | - 9 09    |
| $\frac{1}{2}$ | 72 8800           | 8807                     | 0139                         | - 23 07   | 2             | 53 1240           |                          |                              |           |
| $\frac{1}{2}$ | 72 4185           |                          |                              |           | 2             | 45 2885           |                          |                              |           |
| 2             | 54 7562           |                          |                              |           | $\frac{1}{2}$ | 45 2552           | 2402                     | 0015                         | + 1 57    |

|                     |         |
|---------------------|---------|
| Weighted mean ..... | + 5 85  |
| $V_a$ .....         | - 20 98 |
| $V_d$ .....         | - 14    |
| Curvature .....     | - 28    |

|                       |        |
|-----------------------|--------|
| Radial velocity ..... | - 15 5 |
|-----------------------|--------|

<sup>4</sup> Check measurement.

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$\alpha$  CORONÆ BOREALIS, 973 (b).

1907. Aug. 1.  
G. M. T. 11<sup>h</sup> 20<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0342           |                          |                              |           | 1 $\frac{1}{2}$   | 45.2752           | .2335                    | .0052                        | - 5.43    |
| 2   | 45.3153           |                          |                              |           |   |                   |                          |                              |           |
|     |                   |                          |                              |           | $V_s$ ..... - 5.43<br>$V_a$ ..... - 20.98<br>$V_d$ ..... .14<br>Curvature..... .28<br>Radial velocity..... 26.8 |                   |                          |                              |           |

$\alpha$  CORONÆ BOREALIS, 978.

1907. Aug. 3.  
G. M. T. 13<sup>h</sup> 02<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|--|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9938           |                          |                              |           | 2  | 45.2426           | .2434                    | .0054                        | - 5.65    |
| 1   | 72.8526           | .8224                    | .0037                        | + 5.37    | 1  | 27.4524           | .1800                    | .0165                        | - 6.40    |
| 2   | 72.4294           |                          |                              |           | 2  | 27.2910           |                          |                              |           |
| 2   | 45.2828           |                          |                              |           |  |                   |                          |                              |           |
|     |                   |                          |                              |           | Weighted mean..... - 3.08<br>$V_a$ ..... - 20.98<br>$V_d$ ..... .08<br>Curvature..... .28<br>Radial velocity..... - 24.4 |                   |                          |                              |           |

$\alpha$  CORONÆ BOREALIS, 986.

1907. Aug. 6.  
G. M. T. 16<sup>h</sup> 38<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|--|-------------------|--------------------------|------------------------------|-----------|
| 2               | 72.9297           |                          |                              |           | 2  | 54.6972           |                          |                              |           |
| 1               | 72.8025           | .8363                    | .0176                        | + 25.57   | 1 $\frac{1}{2}$  | 53.0647           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72.3657           |                          |                              |           | 2  | 45.2377           |                          |                              |           |
| 1               | 53.9672           | .0000                    | .0434                        | + [50.08] | 1  | 45.2437           | .2877                    | .0390                        | + 34.00   |
|                 |                   |                          |                              |           | Weighted mean..... + 29.78<br>$V_a$ ..... - 20.96<br>$V_d$ ..... .27<br>Curvature..... .28<br>Radial velocity..... + 8.3 |                   |                          |                              |           |

$\alpha$  CORONÆ BOREALIS, 986.\*

1907. Aug. 6.  
G. M. T. 16<sup>h</sup> 38<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9624           |                          |                              |           | 1   | 54 0154           | 54 0019                  | 0553                         | + [63.93] |
| 1   | 72 8494           | 72 8504                  | 0317                         | + 46.06   | 2   | 45 2934           |                          |                              |           |
| 2   | 72 3088           |                          |                              |           | 1½  | 45 2948           | 45 2850                  | 0363                         | + 38.00   |
| 1   | 54 0288           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... + 41.22  
 $V_a$  ..... - 20.96  
 $V_d$  ..... - .27  
 Curvature ..... - .28  
 Radial velocity ..... + 19.7

\*Check measurement.

$\alpha$  CORONÆ BOREALIS, 1006.

1907. Aug. 12.  
G. M. T. 16<sup>h</sup> 36<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 8216           |                          |                              |           | 1   | 53 9092           | 53 9903                  | 0205                         | + [23.66] |
| 1½  | 72 6891           | 72 8694                  | 0016                         | + 2.32    | 2   | 45 2372           |                          |                              |           |
| 2   | 72 2641           |                          |                              |           | ½   | 45 2140           | 45 2504                  | 0117                         | + 12.25   |
| 2   | 53 9477           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... + 7.28  
 $V_a$  ..... - 20.76  
 $V_d$  ..... - .23  
 Curvature ..... - .28  
 Radial velocity ..... - 14.0

$\alpha$  CORONÆ BOREALIS, 1014.

1907. Aug. 15.  
G. M. T. 15<sup>h</sup> 09<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9915           |                          |                              |           | 2   | 53 9757           | 53 9813                  | 0115                         | + [13.24] |
| 1½  | 72 8396           | 72 8573                  | 0075                         | - 10.88   | 2   | 53 1065           |                          |                              |           |
| 2   | 72 4290           |                          |                              |           | 2   | 45 2707           |                          |                              |           |
| 2   | 54 7321           |                          |                              |           | ½   | 45 2197           | 45 2226                  | 0161                         | + 16.81   |

Weighted mean ..... + 13.84  
 $V_a$  ..... - 20.58  
 $V_d$  ..... - .24  
 Curvature ..... - .28  
 Radial velocity ..... - 7.3

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$\alpha$  CORONÆ BOREALIS, 1017.

1907. Aug. 22.  
G. M. T. 15<sup>h</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1 $\frac{1}{2}$ | 45.7844           | .....                    | .....                        | .....     | $\frac{1}{4}$ | 45.7576           | 45.2448                  | .0061                        | + 6.37    |

$V_s$  ..... + 6.37  
 $V_a$  ..... - 19.90  
 $V_d$  ..... - 29  
 Curvature ..... - 28

Radial velocity ..... - 14.0

$\alpha$  CORONÆ BOREALIS, 1022.

1907. Aug. 23.  
G. M. T. 14<sup>h</sup> 46<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 56.6754           | .....                    | .....                        | .....     | 2             | 45.2730           | .....                    | .....                        | .....     |
| 1   | 54.0042           | 53.9960                  | .0262                        | + [30.16] | $\frac{1}{2}$ | 45.2628           | 45.2634                  | .0247                        | + 25.78   |
| 2   | 53.1214           | .....                    | .....                        | .....     |               |                   |                          |                              |           |

$V_s$  ..... + 25.78  
 $V_a$  ..... - 19.80  
 $V_d$  ..... - 24  
 Curvature ..... - 28

Radial velocity ..... + 5.5

$\alpha$  CORONÆ BOREALIS, 1026.

1907. Aug. 27.  
G. M. T. 12<sup>h</sup> 06<sup>m</sup>

Observed by } W. E. HARPER.  
Measured by }

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 73.0220           | .....                    | .....                        | .....     | 2              | 45.2880           | .....                    | .....                        | .....     |
| $2\frac{1}{2}$ | 72.9344           | 72.9232                  | .0584                        | + 84.74   | $\frac{1}{8}$  | 27.4870           | 27.4500                  | .0281                        | + 32.50   |
| $2\frac{1}{2}$ | 72.4630           | .....                    | .....                        | .....     | $2\frac{1}{8}$ | 27.2840           | .....                    | .....                        | .....     |
| $2\frac{1}{8}$ | 54.0444           | .....                    | .....                        | .....     | $\frac{1}{8}$  | 45.2840           | 45.2696                  | .0310                        | + 32.36   |
| $\frac{1}{8}$  | 54.0000           | 53.9844                  | .0146                        | + [16.80] |                |                   |                          |                              |           |

Weighted mean ..... + 49.87  
 $V_a$  ..... - 19.35  
 $V_d$  ..... - 19  
 Curvature ..... - 28

Radial velocity ..... + 30.0

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 $\alpha$  CORONÆ BOREALIS, 1032.1907, Sept. 6.  
G. M. T. 13<sup>h</sup> 43<sup>m</sup>Observed by J. N. TRIBBLE.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73·0155           |                          |                              |           | 2             | 45·2322           |                          |                              |           |
| $\frac{1}{2}$ | 72·8710           | 72·8631                  | ·0017                        | - 2·46    | 1             | 45·1848           | 45·2273                  | ·0114                        | - 13·05   |
| 2             | 72·4595           |                          |                              |           | $\frac{1}{2}$ | 27·3558           | 27·4204                  | ·0078                        | - 6·77    |
| 2             | 54·7134           |                          |                              |           | 2             | 27·1818           |                          |                              |           |
| $\frac{1}{2}$ | 53·9660           | 53·9634                  | ·0064                        | - [7·36]  | $\frac{1}{2}$ | 11·7425           | 11·8493                  | ·0021                        | - 1·57    |
| 2             | 53·0832           |                          |                              |           | 2             | 11·4098           |                          |                              |           |

Weighted mean ..... - 4·50  
 $V_a$  ..... - 17·34  
 $V_d$  ..... - 25  
 Curvature ..... - 28

Radial velocity ..... - 22·4

 $\alpha$  CORONÆ BOREALIS, 1067.1907, Sept. 12.  
G. M. T. 14<sup>h</sup> 40<sup>m</sup>Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72·9383           |                          |                              |           | 1             | 45·1575           | 45·2878                  | ·0491                        | + 51·20   |
| $\frac{1}{2}$ | 72·8230           | 72·8950                  | ·0302                        | + 43·82   | $\frac{1}{2}$ | 27·3467           | 27·5090                  | ·0964                        | + 83·52   |
| 2             | 72·3715           |                          |                              |           | 2             | 27·0843           |                          |                              |           |
| 2             | 45·1433           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... + 52·93  
 $V_a$  ..... - 16·20  
 $V_d$  ..... - 28  
 Curvature ..... - 28

Radial velocity ..... + 36·2

 $\alpha$  CORONÆ BOREALIS, 1047.1907, Sept. 18.  
G. M. T. 12<sup>h</sup> 50<sup>m</sup>Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73·1431           |                          |                              |           | 2   | 45·3762           |                          |                              |           |
| 1             | 72·9930           | 72·8596                  | ·0052                        | - 7·55    | 1   | 45·3585           | 45·2560                  | ·0173                        | + 18·06   |
| $\frac{1}{2}$ | 72·5787           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... + 5·25  
 $V_a$  ..... - 14·94  
 $V_d$  ..... - 25  
 Curvature ..... - 28

Radial velocity ..... - 10·2



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$\alpha$  CORONÆ BOREALIS, 1048.

1907, Sept. 18.  
G. M. T. 13<sup>h</sup> 16<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by W. E. HARPER and J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0030           |                          |                              |           | $\frac{1}{2}$ | 53 9418           | 53 9718                  | 0020                         | + [2 30]  |
| $\frac{1}{3}$ | 72 8649           | 72 8695                  | 0047                         | + 6 82    | 2             | 53 0866           |                          |                              |           |
| 2             | 72 4433           |                          |                              |           | 2             | 45 1702           |                          |                              |           |
| 2             | 57 8023           |                          |                              |           | 1             | 45 1457           | 45 2339                  | 0048                         | - 5 00    |
| 1             | 57 7850           | 57 7895                  | 0373                         | -(11 91)  | $\frac{1}{2}$ | 27 3310           | 27 3870                  | 0256                         | - 22 22   |
| 2             | 54 7113           |                          |                              |           | 2             | 27 1905           |                          |                              |           |

Weighted mean . . . . . - 4 09  
 $V_a$  . . . . . - 14 94  
 $V_d$  . . . . . - 28  
 Curvature . . . . . - 28

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Radial velocity . . . . . - 19 6

$\alpha$  CORONÆ BOREALIS, 1060.

1907, Sept. 20.  
G. M. T. 13<sup>h</sup> 35<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0990           |                          |                              |           | 2             | 53 0627           |                          |                              |           |
| $\frac{1}{3}$ | 72 8367           | 72 8376                  | 00272                        | - 39 46   | 2             | 45 2140           |                          |                              |           |
| 2             | 72 4435           |                          |                              |           | 1             | 45 1690           | 45 2286                  | 0101                         | - 10 54   |
| 2             | 54 6952           |                          |                              |           | $\frac{1}{2}$ | 27 3412           | 27 4192                  | 0066                         | + 5 73    |
| $\frac{1}{3}$ | 53 8872           | 53 9352                  | 0346                         | -(39 82)  | 2             | 27 1682           |                          |                              |           |

Weighted mean . . . . . - 10 02  
 $V_a$  . . . . . - 14 52  
 $V_d$  . . . . . + 02  
 Curvature . . . . . - 28

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Radial velocity . . . . . - 24 8

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*a* CORONÆ BOREALIS, 1083.1907. October 1.  
G. M. T. 13<sup>h</sup> 44<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73.0679           |                          |                              |           | 2   | 45.3609           |                          |                              |           |
| 2   | 72.9652           | 72.9078                  | 0430                         | +62.39    | 2   | 45.3694           | 45.2857                  | 0470                         | +49.07    |
| 2   | 72.5002           |                          |                              |           | 2   | 27.5686           | 27.4492                  | 0366                         | +31.77    |
| 2   | 54.8129           |                          |                              |           | 2   | 27.3661           |                          |                              |           |
| 2   | 54.0989           | 54.0261                  | 0563                         | +64.80    | 1   | 12.0432           | 11.9027                  | 0513                         | +38.42    |
| 2   | 53.1867           |                          |                              |           | 2   | 11.6482           |                          |                              |           |

Weighted mean ..... +43.25  
 $V_a$  ..... -12.21  
 $V_d$  ..... - .28  
 Curvature ..... - .28

Radial velocity ..... +30.5

*a* CORONÆ BOREALIS, 1084.1907. Oct. 1.  
G. M. T. 13<sup>h</sup> 56<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72.9948           |                          |                              |           | 2   | 45.2968           |                          |                              |           |
| 2   | 72.8698           | 72.8852                  | 0204                         | +29.60    | 2   | 45.2912           | 45.2680                  | 0203                         | +30.59    |
| 2   | 72.4285           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... +30.27  
 $V_a$  ..... -12.21  
 $V_d$  ..... - .28  
 Curvature ..... - .28

Radial velocity ..... +17.5

*a* CORONÆ BOREALIS, 1393.1908. March 9.  
G. M. T. 22<sup>h</sup> 08<sup>m</sup>Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.8725           |                          |                              |           | 2   | 27.5088           | 27.4056                  | 0670                         | -6.08     |
| 1   | 54.0542           | 53.9269                  | 0429                         | -[49.38]  | 3   | 27.3499           |                          |                              |           |
| 2   | 53.2361           |                          |                              |           | 1   | 11.9342           | 11.8522                  | 0008                         | +0.60     |
| 3   | 45.3847           |                          |                              |           | 3   | 11.5892           |                          |                              |           |
| 2   | 45.3252           | 45.2141                  | 0216                         | -25.68    |     |                   |                          |                              |           |

Weighted mean ..... -10.94  
 $V_a$  ..... +16.98  
 $V_d$  ..... - .05  
 Curvature ..... - .28

Radial velocity ..... +5.7

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$\alpha$  CORONÆ BOREALIS, 1323\*.

1908. March 9.  
G. M. T. 22<sup>h</sup> 08<sup>m</sup>

Observed by W. E. HARPER.  
Measured by C. R. WESTLAND.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 51.7344           |                          |                              |           | 1   | 27.3712           | 27.3992                  | .0134                        | -11.63    |
| 2   | 53.9241           | 53.9316                  | .0382                        | -[43.97]  | 2   | 27.2184           |                          |                              |           |
| 2   | 53.1045           |                          |                              |           | 1   | 11.7835           | 11.8301                  | .0213                        | -15.95    |
| 2   | 45.2517           |                          |                              |           | 2   | 11.4603           |                          |                              |           |
| 2   | 45.1867           | 45.2087                  | .0300                        | -31.32    |     |                   |                          |                              |           |

Weighted mean..... -22.55  
 $V_a$ ..... +16.98  
 $V_d$ ..... - .05  
 Curvature..... - .28

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Radial velocity..... - 5.9

Note.—(Mg. line omitted). \* Check measurement.

$\alpha$  CORONÆ BOREALIS, 1393.\*

1908. March 9.  
G. M. T. 22<sup>h</sup> 08<sup>m</sup>

Observed by W. E. HARPER.  
Measured by

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7502           |                          |                              |           | 1½  | 45.2112           | 45.2051                  | .0336                        | -35.08    |
| 1   | 53.9539           | 53.9413                  | .0285                        | -[32.80]  | 1   | 27.3758           | 27.3827                  | .0299                        | -25.95    |
| 2   | 53.1290           |                          |                              |           | 2   | 27.2397           |                          |                              |           |
| 2   | 45.2797           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -31.43  
 $V_a$ ..... +16.98  
 $V_d$ ..... - .05  
 Curvature..... - .28

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Radial velocity..... - 14.8

\* Check measurement.

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$\alpha$  CORONÆ BOREALIS, 1402.

1908, March 16.  
G. M. T. 21<sup>h</sup> 02<sup>m</sup>

Observed by F. W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1   | 54 7845           |                          |                              |           | 1   | 27 5345           | 27 3875                  | 0251                         | -21.79    |
| 1   | 53 9802           | 53 9412                  | 0286                         | - [32.92] | 2   | 27 3906           |                          |                              |           |
| 1   | 53 1475           |                          |                              |           | 1½  | 11 9963           | 11 7940                  | 0574                         | -43.00    |
| 1   | 45 3466           |                          |                              |           | 2   | 11 7098           |                          |                              |           |
| 1   | 45 2680           | 45 1960                  | 0427                         | -44.58    |     |                   |                          |                              |           |

Weighted mean ..... -37.89  
 $V_a$  ..... +29.74  
 $V_d$  ..... .00  
 Curvature ..... .28  
 Radial velocity ..... - 16.9

$\alpha$  CORONÆ BOREALIS, 1403.

1908, April 15.  
G. M. T. 19<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 45 2842           |                          |                              |           | 2   | 15 5026           |                          |                              |           |
| 1   | 45 2361           | 45 2254                  | 0133                         | -13.88    | ½   | 15 5417           | 15 4377                  | 0356                         | -27.55    |
| 1   | 27 4702           | 27 4039                  | 0087                         | - 7.55    | 1½  | 11 9500           | 11 8426                  | 0088                         | - 6.59    |
| 2   | 27 3135           |                          |                              |           | 2   | 11 6149           |                          |                              |           |

Weighted mean ..... -13.89  
 $V_a$  ..... 5.85  
 $V_d$  ..... .04  
 Curvature ..... .28  
 Radial velocity ..... - 8.4

$\alpha$  CORONÆ BOREALIS, 1493.\*

1908, April 15.  
G. M. T. 19<sup>h</sup> 18<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9717           |                          |                              |           | 2   | 45 2267           | 45 2191                  | 0196                         | -20.46    |
| 1½  | 72 8300           | 72 8678                  | 0030                         | + 4.35    | 1½  | 27 4633           | 27 4012                  | 0114                         | - 9.89    |
| 2   | 72 4080           |                          |                              |           | 2   | 27 3090           |                          |                              |           |
| 2   | 45 2812           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean ..... - 9.85  
 $V_a$  ..... + 5.85  
 $V_d$  ..... .04  
 Curvature ..... .28

Radial velocity ..... - 4.3

\*Check measurement.

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$\alpha$  CORONÆ BOREALIS, 1565.

1908, June 1,  
G. M. T. 18<sup>m</sup>

Observed by T. H. PARKER.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.  | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|------------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 72 9938           |                          |                              |            | 2               | 45 3014           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72 8490           | 72 8648                  | 0000                         | $\pm 0.00$ | 1               | 27 4890           | 27 4251                  | 0125                         | +10.85    |
| 2               | 72 4316           |                          |                              |            | 2               | 27 3107           |                          |                              |           |
| 2               | 54 7550           |                          |                              |            | 1 $\frac{1}{2}$ | 15 5412           | 15 4528                  | 0105                         | - 8.13    |
| 1               | 54 0110           | 53 9920                  | 0222                         | + [25.56]  | 2               | 15 4900           |                          |                              |           |
| 2               | 53 1370           |                          |                              |            | 2               | 11 9275           | 11 8338                  | 0176                         | - 9.13    |
| 2               | 45 2605           | 45 2355                  | 0032                         | 3.34       | 2               | 11 6009           |                          |                              |           |
| Weighted mean   |                   |                          |                              |            |                 |                   |                          |                              | 2.59      |
| $V_a$           |                   |                          |                              |            |                 |                   |                          |                              | 10.43     |
| $V_d$           |                   |                          |                              |            |                 |                   |                          |                              | .20       |
| Curvature       |                   |                          |                              |            |                 |                   |                          |                              | .28       |
| Radial velocity |                   |                          |                              |            |                 |                   |                          |                              | 13.5      |

$\alpha$  CORONÆ BOREALIS, 1566.

1908, June 1,  
G. M. T. 18<sup>m</sup> 42<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. T. H. PARKER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 45 2929           |                          |                              |           | 1 $\frac{1}{2}$ | 27 4641           | 27 4107                  | 0019                         | - 1.64    |
| 2               | 45 2461           | 45 2267                  | 0120                         | - 12.52   | 2               | 27 3000           |                          |                              |           |
| 2               | 43 5585           |                          |                              |           | Weighted mean   |                   |                          |                              | -10.34    |
| $V_a$           |                   |                          |                              |           |                 |                   |                          |                              | -10.43    |
| $V_d$           |                   |                          |                              |           |                 |                   |                          |                              | .20       |
| Curvature       |                   |                          |                              |           |                 |                   |                          |                              | .28       |
| Radial velocity |                   |                          |                              |           |                 |                   |                          |                              | - 20.2    |

$\alpha$  CORONÆ BOREALIS, 1571.

1908, June 3,  
G. M. T. 16<sup>m</sup> 32<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2               | 73 0427           |                          |                              |           | 1               | 27 4899           | 27 4253                  | 0127                         | +11.02    |
| 1               | 72 9099           | 72 9760                  | 0112                         | +16.25    | 2               | 27 3115           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72 4822           |                          |                              |           | 1 $\frac{1}{2}$ | 15 5378           | 15 4464                  | 0269                         | - 20.82   |
| 2               | 45 2815           |                          |                              |           | 2               | 15 4900           |                          |                              |           |
| 2               | 45 2437           | 45 2358                  | 0029                         | - 3.03    | Weighted mean   |                   |                          |                              | + 2.40    |
| $V_a$           |                   |                          |                              |           |                 |                   |                          |                              | -11.02    |
| $V_d$           |                   |                          |                              |           |                 |                   |                          |                              | .07       |
| Curvature       |                   |                          |                              |           |                 |                   |                          |                              | .28       |
| Radial velocity |                   |                          |                              |           |                 |                   |                          |                              | 9.0       |

$\alpha$  CORONÆ BOREALIS, 1572.

1908. June 3.  
G. M. T. 16<sup>h</sup> 52<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by C. R. WESTLAND.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 54 7690           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 27 3380           | .....                    | .....                        | .....     |
| $\frac{1}{2}$ | 53 9965           | 53 9706                  | 0008                         | - [1 16]  | $\frac{1}{2}$ | 15 5674           | 15 4394                  | 0039                         | -26 24    |
| $\frac{1}{2}$ | 53 1417           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 15 5266           | .....                    | .....                        | .....     |
| $\frac{1}{2}$ | 45 3179           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 11 9767           | 11 8434                  | 0080                         | - 5 99    |
| $\frac{1}{2}$ | 45 2866           | 45 2423                  | 0036                         | - 3 76    | $\frac{1}{2}$ | 11 6410           | .....                    | .....                        | .....     |
| $\frac{1}{2}$ | 27 4982           | 27 4073                  | 0053                         | - 4 60    |               |                   |                          |                              |           |

Weighted mean ..... - 3 98  
 $V_a$  ..... -11 02  
 $V_d$  ..... - 08  
 Curvature ..... - 28  
 Radial velocity ..... - 15 4

$\alpha$  CORONÆ BOREALIS, 1572\*.

1908. June 3.  
G. M. T. 16<sup>h</sup> 52<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 53 9962           | 53 9677                  | 0021                         | - [ 2 41] | 2   | 27 3409           | .....                    | .....                        | .....     |
| $\frac{1}{2}$ | 54 7700           | .....                    | .....                        | .....     | 1   | 15 5560           | 15 4260                  | 00473                        | -36 61    |
| 2             | 45 3195           | .....                    | .....                        | .....     | 2   | 15 5286           | .....                    | .....                        | .....     |
| 1             | 45 2856           | 45 2396                  | 0009                         | + 0 93    | 2   | 11 9830           | 11 8501                  | 0013                         | - 9 74    |
| 2             | 43 5855           | .....                    | .....                        | .....     | 2   | 11 6401           | .....                    | .....                        | .....     |
| 2             | 27 5096           | 27 4153                  | 0027                         | + 2 34    |     |                   |                          |                              |           |

Weighted mean ..... - 8 41  
 $V_a$  ..... -11 02  
 $V_d$  ..... - 08  
 Curvature ..... - 28  
 Radial velocity ..... - 19 8

\* Check measurement.

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$\alpha$  CORONÆ BOREALIS, 1581.

1908, June 5,  
G. M. T. 17<sup>h</sup> 31<sup>m</sup>

Observed by } W. E. HARPER  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9780           | .....                    | .....                        | .....     | 1     | 27 3975           | 27 4026                  | 0100                         | - 8.63    |
| 1   | 72 8406           | 72 8688                  | 0040                         | + 5.80    | 2     | 27 2433           | .....                    | .....                        | .....     |
| 2   | 72 4202           | .....                    | .....                        | .....     | 1     | 11 8584           | 11 8491                  | 0023                         | - 1.72    |
| 2   | 45 2545           | .....                    | .....                        | .....     | 2     | 11 5145           | .....                    | .....                        | .....     |
| 2   | 45 2387           | 45 2578                  | 0191                         | + 19.94   | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean ..... - 7.06  
 $V_a$  ..... - 11.62  
 $V_d$  ..... - .14  
 Curvature ..... - .28  
 Radial velocity ..... - 5.0

$\alpha$  CORONÆ BOREALIS, 1601.

1908, June 12,  
G. M. T. 16<sup>h</sup> 56<sup>m</sup>

Observed by } W. E. HARPER  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 72 9665           | .....                    | .....                        | .....     | 2               | 53 0720           | .....                    | .....                        | .....     |
| 1             | 72 8330           | 72 8678                  | 0030                         | + 4.35    | 2               | 45 2242           | 45 2568                  | 0181                         | + 23.18   |
| 1             | 72 4060           | .....                    | .....                        | .....     | 2               | 45 2410           | .....                    | .....                        | .....     |
| 2             | 54 7068           | .....                    | .....                        | .....     | 1 $\frac{1}{2}$ | 27 4228           | 27 4370                  | 0244                         | + 21.27   |
| $\frac{1}{2}$ | 53 9350           | 53 9725                  | 0027                         | + [3 11]  | 2               | 27 2322           | .....                    | .....                        | .....     |

Weighted mean ..... + 20.58  
 $V_a$  ..... - 13.59  
 $V_d$  ..... - .12  
 Curvature ..... - .28  
 Radial velocity ..... + 6.6

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 $\alpha$  CORONÆ BOREALIS, 1608.1908, June 17,  
G. M. T. 13<sup>h</sup> 53<sup>m</sup>Observed by } W. E. HARPER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 72 9809           | .....                    | .....                        | .....     | 2   | 45 2620           | .....                    | .....                        | .....     |
| 1   | 72 8361           | 72 8662                  | 0014                         | + 2 03    | 2   | 45 2390           | 45 2506                  | 0019                         | +12 42    |
| 2   | 72 4112           | .....                    | .....                        | .....     | 1   | 27 4892           | 27 4739                  | 0063                         | +53 21    |
| 2   | 54 7169           | .....                    | .....                        | .....     | 2   | 27 2621           | .....                    | .....                        | .....     |
| 1   | 53 9506           | 53 9716                  | 0018                         | - [2 07]  | 1   | 11 9270           | 11 8964                  | 00450                        | +33 70    |
| 2   | 53 0941           | .....                    | .....                        | .....     | 2   | 11 5379           | .....                    | .....                        | .....     |

Weighted mean..... +23 76  
 $V_a$ ..... -14 85  
 $V_d$ ..... - 07  
 Curvature..... - 28  
 Radial velocity..... + 8 6

 $\alpha$  CORONÆ BOREALIS, 1623.1908, June 22,  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7556           | .....                    | .....                        | .....     | 1     | 27 4580           | 27 4130                  | 0004                         | + 3 47    |
| 2   | 53 9719           | 53 9559                  | 0139                         | - [16 00] | 3     | 27 2899           | .....                    | .....                        | .....     |
| 2   | 53 1320           | .....                    | .....                        | .....     | 1     | 11 9219           | 11 8454                  | 0060                         | - 4 49    |
| 2   | 45 2819           | .....                    | .....                        | .....     | 2     | 11 5853           | .....                    | .....                        | .....     |
| 1   | 45 2571           | 45 2511                  | 0124                         | +12 93    | ..... | .....             | .....                    | .....                        | .....     |

Weighted mean..... + 3 97  
 $V_a$ ..... -16 16  
 $V_d$ ..... - 16  
 Curvature..... - 28  
 Radial velocity..... -12



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$\alpha$  CORONÆ BOREALIS, 1623.

1908, June 22,  
G. M. T. 16<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0044           |                          |                              |           | 2   | 45 3000           |                          |                              |           |
| 1   | 72 8548           | 72 8598                  | 0050                         | 7.25      | 1   | 45 2624           | 45 2364                  | 0023                         | - 2.40    |
| 2   | 72 4483           |                          |                              |           | 1   | 27 4675           | 27 4195                  | 0024                         | 2.08      |
| 2   | 54 7536           |                          |                              |           | 3   | 27 2952           |                          |                              |           |
| 2   | 53 9681           | 53 9531                  | 0167                         | [19.22]   | 1   | 11 9274           | 11 8591                  | 0080                         | 5.99      |
| 2   | 53 1381           |                          |                              |           | 2   | 11 5790           |                          |                              |           |

Weighted mean..... - 1.44  
 $V_a$ ..... - 16.16  
 $V_d$ ..... - 16  
 Curvature..... - .28

\*Check measurement.

Radial velocity..... - 18.9

$\alpha$  CORONÆ BOREALIS, 1624.

1908, June 22,  
G. M. T. 16<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-------|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2     | 54 7898           |                          |                              |           | 1/2   | 27 4840           | 27 4175                  | 0049                         | + 4.34    |
| 1     | 54 0178           | 53 9700                  | 0062                         | [0.09]    | 2     | 27 3131           |                          |                              |           |
| 2     | 53 1597           |                          |                              |           | 1 1/2 | 11 9423           | 11 8612                  | 0098                         | + 7.34    |
| 2     | 45 3251           |                          |                              |           | 2     | 11 5883           |                          |                              |           |
| 1 1/2 | 45 2880           | 45 2365                  | 0023                         | - 2.40    |       |                   |                          |                              |           |

Weighted mean..... + 4.02  
 $V_a$ ..... - 16.16  
 $V_d$ ..... - 16  
 Curvature..... - .28

Radial velocity..... - 12.6

$\alpha$  CORONÆ BOREALIS, 1628.

1908, June 24,  
G. M. T. 15<sup>h</sup> 26<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.   | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54 7838           |                          |                              |           | 1     | 27 4598           | 27 4158                  | 0032                         | + 2.7     |
| 1/2 | 53 9417           | 53 9000                  | 0098                         | [80.33]   | 2     | 27 2908           |                          |                              |           |
| 2   | 53 1536           |                          |                              |           | 1 1/2 | 11 9065           | 11 8705                  | 0191                         | + 14.30   |
| 2   | 45 3060           |                          |                              |           | 2     | 11 5432           |                          |                              |           |
| 1   | 45 2761           | 45 2436                  | 0019                         | + 5.12    |       |                   |                          |                              |           |

Weighted mean..... + 8.38  
 $V_a$ ..... - 16.65  
 $V_d$ ..... - 97  
 Curvature..... - .28

Radial velocity..... - 8.6

9-10 EDWARD VII., A. 1910

α CORONÆ BOREALIS, 1629.

1908. June 24.  
G. M. T. 15<sup>h</sup> 40<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1              | 73 0846           |                          |                              |           | 2             | 45 3268           |                          |                              |           |
| $\frac{1}{2}$  | 72 9449           | 72 8698                  | 0050                         | + 7 26    | 1             | 45 2795           | 45 2263                  | 0121                         | - 12 95   |
| 1              | 72 5206           |                          |                              |           | $\frac{1}{2}$ | 27 4625           | 27 4000                  | 0126                         | - 10 93   |
| 2              | 54 7999           |                          |                              |           | 2             | 27 3093           |                          |                              |           |
| $1\frac{1}{2}$ | 54 0511           | 53 9939                  | 0241                         | + [27 74] | 1             | 11 9256           | 11 8711                  | 0197                         | + 14 77   |
| 2              | 53 1682           |                          |                              |           | 2             | 11 5643           |                          |                              |           |

Weighted mean..... 0 00  
 $V_a$ ..... - 16 66  
 $V_d$ ..... - 11  
 Curvature..... - 28

Radial velocity..... - 17 0

α CORONÆ BOREALIS, 1638.

1908. June 26.  
G. M. T. 15<sup>h</sup> 51<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 73 0800           |                          |                              |           | $1\frac{1}{2}$ | 45 3098           | 45 2238                  | 0149                         | - 15 56   |
| 1   | 72 9496           | 72 8476                  | 0172                         | - 24 96   | 2              | 45 3565           |                          |                              |           |
| 1   | 72 5498           |                          |                              |           | 2              | 27 4673           | 27 3933                  | 0193                         | - 16 80   |
| 2   | 54 8334           |                          |                              |           | 3              | 27 3236           |                          |                              |           |
| 1   | 54 0511           | 53 9601                  | 0097                         | - [11 31] | 2              | 11 9232           | 11 8627                  | 0113                         | + 8 46    |
| 2   | 53 2007           |                          |                              |           | 3              | 11 5652           |                          |                              |           |

Weighted mean..... - 10 00  
 $V_a$ ..... - 14 50  
 $V_d$ ..... - 11  
 Curvature..... - 28

Radial velocity..... - 24 9

α CORONÆ BOREALIS, 1639.

1908. June 26th.  
G. M. T. 15<sup>h</sup> 51<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1              | 73 0632           |                          |                              |           | 2              | 53 1470           |                          |                              |           |
| 1              | 72 9112           | 72 8562                  | 0086                         | - 12 48   | 2              | 45 3037           |                          |                              |           |
| 1              | 72 5014           |                          |                              |           | $1\frac{1}{2}$ | 45 2656           | 45 2376                  | 0011                         | - 1 15    |
| $1\frac{1}{2}$ | 54 7831           |                          |                              |           | $1\frac{1}{2}$ | 27 4499           | 27 4169                  | 0043                         | + 3 73    |
| 1              | 54 0126           | 53 9776                  | 0078                         | + [ 8 98] | 2              | 27 2799           |                          |                              |           |

Weighted mean..... - 2 40  
 $V_a$ ..... - 14 81  
 $V_d$ ..... - 11  
 Curvature..... - 28

Radial velocity..... - 17 6

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$\alpha$  CORONÆ BOREALIS, 1646.

1908, June 27,  
G. M. T. 16<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.  | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|------------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1 $\frac{1}{2}$ | 73 0138           |                          |                              |            | 1               | 45 2252           | 45 2282                  | 0105                         | - 10 95   |
| 1 $\frac{1}{2}$ | 72 8550           | 72 8552                  | 0096                         | - 13 92    | 2               | 45 2694           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72 4403           |                          |                              |            | 1 $\frac{1}{2}$ | 27 4472           | 27 4290                  | 0164                         | + 14 23   |
| 2               | 54 7419           |                          |                              |            | 3               | 27 2648           |                          |                              |           |
| 1               | 53 9706           | 53 9751                  | 0053                         | + [ 6 17 ] | 2               | 11 8531           | 11 8231                  | 0283                         | - 21 19   |
| 2               | 53 0627 (?)       |                          |                              |            | 3               | 11 5348           |                          |                              |           |

Weighted mean . . . . . - 7 79  
 $V_a$  . . . . . - 14 98  
 $V_d$  . . . . . - 11  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 23 2

$\alpha$  CORONÆ BOREALIS, 1646\*.

1908, June 27,  
G. M. T. 16<sup>h</sup> 20<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.   | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-------------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1               | 73 0388           |                          |                              |             | 2               | 45 2924           |                          |                              |           |
| 1 $\frac{1}{2}$ | 72 8666           | 72 8466                  | 0182                         | - 26 41     | 1 $\frac{1}{2}$ | 45 2510           | 45 2325                  | 0062                         | - 6 41    |
| 1 $\frac{1}{2}$ | 72 4615           |                          |                              |             | 1 $\frac{1}{2}$ | 27 4381           | 27 4092                  | 0034                         | - 3 05    |
| 2               | 54 7608           |                          |                              |             | 3               | 27 2754           |                          |                              |           |
| 1 $\frac{1}{2}$ | 54 0203           | 54 0038                  | 0340                         | + [ 39 13 ] | 1               | 11 9032           | 11 8575                  | 0061                         | + 5 29    |
| 2               | 53 1283           |                          |                              |             | 3               | 11 5531           |                          |                              |           |

Weighted mean . . . . . - 4 91  
 $V_a$  . . . . . - 14 98  
 $V_d$  . . . . . - 11  
 Curvature . . . . . - 28  
 Radial velocity . . . . . - 20 3

\* Check measurement.

1908. June 27.  
G. M. T. 16<sup>h</sup> 20<sup>m</sup>

$\alpha$  CORONÆ BOREALIS, 1646.\*

Observed by J. S. PLASKETT.  
Measured by W. E. HARPER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
|               | 72 9272           |                          |                              |           | 2   | 45 1872           |                          |                              |           |
|               | 92 7747           | 72 8581                  | 0067                         | - 8 72    | 2   | 45 1430           | 45 2294                  | 0093                         | - 9 71    |
| 1             | 73 3578           |                          |                              |           | 1   | 27 3550           | 27 4286                  | 0160                         | -13 89    |
|               | 54 6545           |                          |                              |           | 2   | 27 1731           |                          |                              |           |
| $\frac{1}{2}$ | 53 8697           | 53 9617                  | 0081                         | - [ 9 32] | 1   | 11 7667           | 11 8341                  | 0173                         | -12 95    |
|               | 53 0153           |                          |                              |           | 2   | 11 4398           |                          |                              |           |

Weighted mean ..... - 5 44  
 $V_a$  ..... -14 98  
 $V_d$  ..... - 11  
 Curvature ..... - 28

\* Check measurement.

Radial velocity ..... - 20 8

1908. June 27.  
G. M. T. 16<sup>h</sup> 40<sup>m</sup>

$\alpha$  CORONÆ BOREALIS, 1647.

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.  |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|------------|
| 1             | 73 9577           |                          |                              |           | 2   | 45 3388           |                          |                              |            |
| $\frac{1}{2}$ | 72 9089           | 72 8589                  | 0059                         | - 8 56    | 1   | 45 3041           | 45 2387                  | 0000                         | $\pm$ 0 00 |
| 1             | 72 5000           |                          |                              |           | 1   | 27 4771           | 27 3801                  | 0235                         | - 20 40    |
| 2             | 54 7978           |                          |                              |           | 2   | 27 3349           |                          |                              |            |
| 1             | 54 0373           | 53 9793                  | 0095                         | - [10 93] | 1   | 11 9502           | 11 8522                  | 0008                         | - 0 60     |
| 2             | 53 1731           |                          |                              |           | 2   | 11 6053           |                          |                              |            |

Weighted mean ..... - 6 59  
 $V_a$  ..... -14 03  
 $V_d$  ..... - 16  
 Curvature ..... - 28

Radial velocity ..... -21 1

1908. July 1.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

$\alpha$  CORONÆ BOREALIS, 1652.

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1             |                   |                          |                              |           | 1   | 45 0548           | 45 3038                  | 0651                         | +67 96    |
| $\frac{1}{2}$ | 72 6304           | 72 8917                  | 0269                         | +38 03    | 2   | 45 0254           |                          |                              |           |
| 1             | 72 1836           |                          |                              |           | 1   | 27 2465           | 27 4801                  | 0675                         | +58 59    |
| 2             | 54 4896           |                          |                              |           | 2   | 27 0134           |                          |                              |           |
| $\frac{1}{2}$ | 53 7812           | 53 0387                  | 0689                         | + [79 30] | 1   | 11 7141           | 11 9391                  | 0877                         | -64 69    |
| 2             | 52 8512           |                          |                              |           | 2   | 11 2829           |                          |                              |           |

Weighted mean ..... -60 07  
 $V_a$  ..... -17 73  
 $V_d$  ..... - 67  
 Curvature ..... - 28

Radial velocity ..... -41 9

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$\alpha$  CORONÆ BOREALIS, 1656.

1908, July 3,  
G. M. T. 15<sup>h</sup> 17<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 54 7645           |                          |                              |           | $\frac{1}{2}$ | 27 4941           | 27 4806                  | 0680                         | +59 02    |
| $\frac{1}{2}$ | 54 0431           | 54 0196                  | 0498                         | + [57 32] | 2             | 27 2599           |                          |                              |           |
| 1             | 53 1362           |                          |                              |           | $\frac{1}{2}$ | 11 8955           | 11 8895                  | 0381                         | +28 54    |
| 1             | 45 2983           |                          |                              |           | 2             | 11 5115           |                          |                              |           |
| $\frac{1}{2}$ | 45 3190           | 45 2943                  | 0556                         | +58 05    |               |                   |                          |                              |           |

Weighted mean ..... +48 53  
 $V_a$  ..... -18 18  
 $V_d$  ..... 11  
 Curvature ..... 28  
 Radial velocity ..... +30 0

$\alpha$  CORONÆ BOREALIS, 1657.

1908, July 3,  
G. M. T. 15<sup>h</sup> 30<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| $\frac{1}{2}$ | 54 6727           |                          |                              |           | 1   | 45 2097           | 45 2817                  | 0430                         | +44 89    |
| $\frac{1}{2}$ | 53 9471           | 54 0011                  | 0313                         | +36 03    | 2   | 44 1900           |                          |                              |           |
| $\frac{1}{2}$ | 53 0497           |                          |                              |           | 1   | 27 3961           | 27 4586                  | 0460                         | +39 93    |
| 1             | 45 2008           |                          |                              |           | 2   | 27 1843           |                          |                              |           |

Weighted mean ..... +42 41  
 $V_a$  ..... 18 18  
 $V_d$  ..... 14  
 Curvature ..... 28  
 Radial velocity ..... +23 8

$\alpha$  CORONÆ BOREALIS, 1665.

1908, July 6,  
G. M. T. 16<sup>h</sup> 50<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72 9602           |                          |                              |           | $\frac{1}{2}$ | 45 2173           | 45 2668                  | 0281                         | +29 34    |
| $\frac{1}{2}$ | 72 8398           | 72 8876                  | 0228                         | +33 08    | 2             | 45 2240           |                          |                              |           |
| 1             | 72 3996           |                          |                              |           | 1             | 27 4983           | 27 4290                  | 0164                         | +14 24    |
| 2             | 54 6898           |                          |                              |           | 2             | 27 2265           |                          |                              |           |
| $\frac{1}{2}$ | 53 9145           | 53 9715                  | 0017                         | + [1 96]  | 1             | 11 8914           | 11 9154                  | 0640                         | +47 93    |
| 2             | 53 0501           |                          |                              |           | 2             | 11 4830           |                          |                              |           |

Weighted mean ..... +31 18  
 $V_a$  ..... -18 72  
 $V_d$  ..... 16  
 Curvature ..... 28  
 Radial velocity ..... +12 0

$\alpha$  CORONÆ BOREALIS, 1673.

1908. July 8.  
G. M. T. 14<sup>h</sup> 59<sup>m</sup>

Observed by } J. B. CANNON.  
Measured by }

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72.9993           |                          |                              |           | 2             | 45.2746           |                          |                              |           |
| $\frac{1}{2}$ | 72.8626           | 72.8721                  | 0073                         | +10.60    | 1             | 45.2392           | 45.2382                  | 0005                         | -0.52     |
| 1             | 72.4371           |                          |                              |           | $\frac{1}{2}$ | 27.4364           | 27.4227                  | 0065                         | +5.64     |
| 2             | 54.7314           |                          |                              |           | 2             | 27.2810           |                          |                              |           |
| $\frac{1}{2}$ | 53.9855           | 53.9920                  | 0222                         | + [25.55] | $\frac{1}{2}$ | 11.9283           | 11.8883                  | 0369                         | +27.63    |
| 2             | 53.1071           |                          |                              |           | 1             | 11.5472           |                          |                              |           |

Weighted mean..... +14.01  
 $V_a$ ..... -19.07  
 $V_d$ ..... -11  
 Curvature..... -28  
 Radial velocity..... -5.4

$\alpha$  CORONÆ BOREALIS, 1674.

1908. July 8.  
G. M. T. 15<sup>h</sup> 11<sup>m</sup>

Observed by } J. B. CANNON.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7242           |                          |                              |           | 1             | 27.4496           | 27.4334                  | 0208                         | +18.05    |
| 1   | 53.9536           | 53.9711                  | 0013                         | + [1.50]  | 2             | 27.2631           |                          |                              |           |
| 2   | 53.0947           |                          |                              |           | $\frac{1}{2}$ | 11.8926           | 11.8651                  | 0137                         | +10.26    |
| 2   | 45.2616           |                          |                              |           | 2             | 11.5351           |                          |                              |           |
| 1   | 45.2583           | 45.2703                  | 0316                         | +32.99    |               |                   |                          |                              |           |

Weighted mean..... +18.98  
 $V_a$ ..... -19.07  
 $V_d$ ..... -11  
 Curvature..... -28  
 Radial velocity..... -0.5

$\alpha$  CORONÆ BOREALIS, 1683.

1908. July 10.  
G. M. T. 13<sup>h</sup> 34<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0309           |                          |                              |           | 2             | 53.1334           |                          |                              |           |
| $\frac{1}{2}$ | 72.8884           | 72.8694                  | 0046                         | +6.67     | 2             | 45.3129           |                          |                              |           |
| 1             | 72.4603           |                          |                              |           | $\frac{1}{2}$ | 45.2667           | 45.2274                  | 0113                         | -11.79    |
| 2             | 54.7682           |                          |                              |           | 1             | 27.4832           | 27.4112                  | 0014                         | -1.22     |
| 1             | 54.0451           | 54.0211                  | 0513                         | + [59.04] | 2             | 27.3188           |                          |                              |           |

Weighted mean..... -1.89  
 $V_a$ ..... -19.38  
 $V_d$ ..... .00  
 Curvature..... -28  
 Radial velocity..... -21.5

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$\alpha$  CORONÆ BOREALIS, 1684.

1908. July 10.  
G. M. T. 13<sup>h</sup> 57<sup>m</sup>.

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0327           |                          |                              |           | 2             | 45.3009           |                          |                              |           |
| $\frac{1}{2}$ | 72.8947           | 72.8737                  | 0089                         | +12.91    | 1             | 45.2694           | 45.2421                  | 0034                         | +3.54     |
| 1             | 72.4598           |                          |                              |           | $\frac{1}{2}$ | 27.4744           | 27.4221                  | 0095                         | +7.81     |
| 2             | 54.7653           |                          |                              |           | 2             | 27.2995           |                          |                              |           |
| $\frac{1}{2}$ | 53.9629           | 53.9399                  | 0299                         | -[34.41]  | $\frac{1}{2}$ | 11.9048           | 11.8363                  | 0151                         | -11.30    |
| 2             | 53.1347           |                          |                              |           | 2             | 11.5759           |                          |                              |           |

Weighted mean ..... - 4.59  
 $V_d$  ..... -19.38  
 $V_d$  ..... .04  
 Curvature ..... .28  
 Radial velocity ..... -15.1

$\alpha$  CORONÆ BOREALIS, 1697.

1908. July 13.  
G. M. T. 15<sup>h</sup> 36<sup>m</sup>.

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72.9735           |                          |                              |           | 2             | 45.2596           |                          |                              |           |
| $\frac{1}{2}$ | 72.8268           | 72.8698                  | 0040                         | -5.80     | $\frac{1}{2}$ | 45.2284           | 45.2424                  | 0037                         | +3.86     |
| 1             | 72.4159           |                          |                              |           | $\frac{1}{2}$ | 27.4218           | 27.3975                  | 0151                         | -13.11    |
| 2             | 54.7199           |                          |                              |           | 2             | 27.2712           |                          |                              |           |
| 1             | 53.9583           | 53.9828                  | 0130                         | + [14.96] | 1             | 11.8656           | 11.8236                  | 0278                         | -20.82    |
| 2             | 53.0846           |                          |                              |           | 2             | 11.5495           |                          |                              |           |

Weighted mean ..... - 8.35  
 $V_d$  ..... -19.79  
 $V_d$  ..... .19  
 Curvature ..... .28  
 Radial velocity ..... -28.6

9-10 EDWARD VII., A. 1910

 $\alpha$  CORONÆ BOREALIS, 1698.1908, July 13  
G. M. T. 15<sup>h</sup> 42<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0061           |                          |                              |           | 2              | 45.2766           |                          |                              |           |
| $\frac{1}{2}$ | 72.8661           | 72.8691                  | .0043                        | + 6.24    | $1\frac{1}{2}$ | 45.2388           | 45.2358                  | .0029                        | - 3.03    |
| 1             | 72.4487           |                          |                              |           | $1\frac{1}{2}$ | 27.4391           | 27.4144                  | .0018                        | + 1.56    |
| 2             | 54.7384           |                          |                              |           | 2              | 27.2716           |                          |                              |           |
| 1             | 53.9504           | 53.9544                  | .0154                        | - [17.72] | 1              | 11.8994           | 11.8619                  | .0105                        | + 7.86    |
| 2             | 53.1069           |                          |                              |           | 2              | 11.5450           |                          |                              |           |

Weighted mean..... - 1.84  
*V<sub>a</sub>*..... - 19.79  
*V<sub>d</sub>*..... - .16  
 Curvature..... - .28  
 Radial velocity..... - 18.4

 $\alpha$  CORONÆ BOREALIS, 1711.1908, July 15.  
G. M. T. 16<sup>h</sup> 24<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1              | 73.0341           |                          |                              |           | $1\frac{1}{2}$ | 45.2779           | 45.2420                  | .0033                        | + 3.44    |
| $\frac{1}{2}$  | 72.8891           | 72.8647                  | .0001                        | - .15     | 1              | 27.4705           | 27.4115                  | .0011                        | - .95     |
| 2              | 54.7729           |                          |                              |           | 2              | 27.3061           |                          |                              |           |
| $1\frac{1}{2}$ | 54.0318           | 53.9990                  | .0292                        | + [33.61] | 1              | 11.9256           | 11.8468                  | .0046                        | - .34     |
| 2              | 53.1470           |                          |                              |           | 2              | 11.5865           |                          |                              |           |
| 2              | 45.3094           |                          |                              |           |                |                   |                          |                              |           |

Weighted mean..... + 3.79  
*V<sub>a</sub>*..... - 20.03  
*V<sub>d</sub>*..... - .22  
 Curvature..... - .28  
 Radial velocity..... - 16.7



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$\alpha$  CORONÆ BOREALIS, 1721.

1908, July 24.  
G. M. T. 13<sup>h</sup> 03<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0620           |                          |                              |           | 2             | 45.3273           |                          |                              |           |
| $\frac{1}{2}$ | 72.9251           | 72.9711                  | 0063                         | + 9.14    | 1             | 45.3010           | 45.2503                  | 0116                         | + 12.10   |
| 1             | 72.5018           |                          |                              |           | $\frac{1}{2}$ | 27.5037           | 27.4317                  | 0191                         | + 15.57   |
| 2             | 54.7950           |                          |                              |           | 2             | 27.3187           |                          |                              |           |
| $\frac{1}{2}$ | 54.0282           | 53.9742                  | 0044                         | + [5.06]  | 1             | 11.9502           | 11.8812                  | 0298                         | + 20.97   |
| 2             | 53.1587           |                          |                              |           | 2             | 11.5759           |                          |                              |           |

Weighted mean..... + 15.25  
 $V_a$ ..... 20.68  
 $V_d$ ..... .04  
 Curvature..... - .28  
 Radial velocity..... 5.7

$\alpha$  CORONÆ BOREALIS, 1722.

1908, July 24.  
G. M. T. 13<sup>h</sup> 21<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0441           |                          |                              |           | 2             | 45.3021           |                          |                              |           |
| $\frac{1}{2}$ | 72.9200           | 72.8872                  | 0224                         | + 32.50   | $\frac{1}{2}$ | 45.3022           | 45.2738                  | 0351                         | + 36.64   |
| 1             | 72.4735           |                          |                              |           | 1             | 27.4681           | 27.4298                  | 0172                         | + 14.93   |
| 2             | 54.7704           |                          |                              |           | 2             | 27.2830           |                          |                              |           |
| $\frac{1}{4}$ | 54.0159           | 53.9881                  | 0183                         | + [21.06] | 1             | 11.9141           | 11.8766                  | 0252                         | + 18.87   |
| 2             | 53.1390           |                          |                              |           | 2             | 11.5446           |                          |                              |           |

Weighted mean..... + 26.25  
 $V_a$ ..... - 20.68  
 $V_d$ ..... .04  
 Curvature..... - .28  
 Radial velocity..... + 5.25

α CORONÆ BOREALIS, 1739.

1908, July 29.  
G. M. T. 15<sup>h</sup> 34<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.            |        |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|----------------------|--------|
| 2             | 73 0080           |                          |                              |           | 2             | 45 2276           |                          |                              |                      |        |
| $\frac{1}{2}$ | 72 8406           | 72 8439                  | 0269                         | -30 33    | $\frac{1}{2}$ | 45 1618           | 45 2078                  | 0309                         | -32 26               |        |
| 2             | 72 4370           |                          |                              |           | $\frac{1}{2}$ | 27 3167           | 27 3697                  | 0519                         | -45 14               |        |
| 2             | 54 7106           |                          |                              |           | 2             | 27 1926           |                          |                              |                      |        |
| 1             | 53 9688           | 54 0038                  | 0340                         | -[30 13]  | $\frac{1}{4}$ | 11 7853           | 11 8623                  | 0109                         | + 8 16               |        |
| 2             | 53 0733           |                          |                              |           | 2             | 11 4290           |                          |                              |                      |        |
|               |                   |                          |                              |           |               |                   |                          |                              | Weighted mean.....   | -29 78 |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_a$ .....          | -20 68 |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_d$ .....          | - 24   |
|               |                   |                          |                              |           |               |                   |                          |                              | Curvature.....       | - 28   |
|               |                   |                          |                              |           |               |                   |                          |                              | Radial velocity..... | -50 0  |

α CORONÆ BOREALIS, 1739.\*

1908, July 29.  
G. M. T. 15<sup>h</sup> 34<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity.            |        |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|----------------------|--------|
| 2             | 73 0854           |                          |                              |           | 2             | 45 3015           |                          |                              |                      |        |
| $\frac{1}{2}$ | 72 9133           | 72 8398                  | 0250                         | -36 27    | 1             | 45 2452           | 45 2173                  | 0214                         | -22 34               |        |
| 2             | 72 5142           |                          |                              |           | $\frac{1}{2}$ | 27 3747           | 27 3581                  | 0545                         | -36 29               |        |
| 2             | 54 7789           |                          |                              |           | 2             | 27 2632           |                          |                              |                      |        |
| $\frac{1}{2}$ | 54 0256           | 53 9903                  | 0265                         | -[25 59]  | 1             | 11 8647           | 11 8697                  | 0183                         | +13 70               |        |
| 2             | 53 1456           |                          |                              |           | 2             | 11 5022           |                          |                              |                      |        |
|               |                   |                          |                              |           |               |                   |                          |                              | Weighted mean.....   | -18 01 |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_a$ .....          | -20 91 |
|               |                   |                          |                              |           |               |                   |                          |                              | $V_d$ .....          | - 22   |
|               |                   |                          |                              |           |               |                   |                          |                              | Curvature.....       | - 28   |
|               |                   |                          |                              |           |               |                   |                          |                              | Radial velocity..... | -39 4  |

\*Check measurement.

SESSIONAL PAPER No. 25a

$\alpha$  CORONÆ BOREALIS, 1748.

1908, July 31,  
G. M. T. 13<sup>h</sup> 38<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0081           |                          |                              |           | 2              | 53.1007           |                          |                              |           |
| $\frac{1}{2}$ | 72.8616           | 72.8641                  | .0007                        | -10.15    | 2              | 45.2666           |                          |                              |           |
| 1             | 72.4501           |                          |                              |           | 1              | 45.1369           | 45.2030                  | .0348                        | -36.33    |
| 2             | 54.7326           |                          |                              |           | $1\frac{1}{2}$ | 27.3968           | 27.3994                  | .0132                        | -11.45    |
| 1             | 53.9342           | 53.9445                  | .0250                        | -[28.77]  | 2              | 27.2521           |                          |                              |           |

Weighted mean . . . . . -19.53  
 $V_a$  . . . . . -20.98  
 $V_d$  . . . . . -14  
 Curvature . . . . . -28  
 Radial velocity . . . . . -40.9

$\alpha$  CORONÆ BOREALIS, 1749.

1908, July 31,  
G. M. T. 13<sup>h</sup> 38<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0321          |                          |                              |           | 2              | 45.2724           |                          |                              |           |
| $\frac{1}{2}$ | 72.8767          | 72.8559                  | .0089                        | -11.91    | $1\frac{1}{2}$ | 45.2269           | 45.2281                  | .0106                        | -11.07    |
| 1             | 72.4611          |                          |                              |           | 1              | 27.4144           | 27.4088                  | .0038                        | -3.30     |
| 2             | 54.7470          |                          |                              |           | 2              | 27.2523           |                          |                              |           |
| 1             | 53.9854          | 53.9816                  | .0118                        | + [13.58] | 1              | 11.8314           | 11.8384                  | .0160                        | -11.98    |
| 2             | 53.1145          |                          |                              |           | 2              | 11.4999           |                          |                              |           |

Weighted mean . . . . . -9.46  
 $V_a$  . . . . . -20.98  
 $V_d$  . . . . . -14  
 Curvature . . . . . -28  
 Radial velocity . . . . . -30.9

9-10 EDWARD VII. A. 1910

 $\alpha$  CORONÆ BOREALIS, 1761.1908. Aug. 5.  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. B. CANNON

| Wt.           | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity |
|---------------|------------------|--------------------------|------------------------------|-----------|----------------|------------------|--------------------------|------------------------------|----------|
| 1             | 73 0655          |                          |                              |           | 2              | 45 2722          |                          |                              |          |
| $\frac{1}{4}$ | 72 9250          | 72 9281                  | 0633                         | +91 85    | $1\frac{1}{2}$ | 45 2899          | 45 2913                  | 0526                         | +54 91   |
| 1             | 72 4451          |                          |                              |           | $\frac{1}{2}$  | 27 4955          | 27 4728                  | 0602                         | +52 25   |
| 2             | 54 7359          |                          |                              |           | 2              | 27 2595          |                          |                              |          |
| $\frac{1}{2}$ | 54 0637          | 54 0699                  | 1002                         | +115 33   | 1              | 11 9402          | 11 9365                  | 0851                         | +63 74   |
| 2             | 53 1655          |                          |                              |           | 2              | 11 5107          |                          |                              |          |

Weighted mean ..... -58 42

 $V_p$  ..... 20 96 $V_d$  ..... 23

Curvature ..... 28

Radial velocity ..... -37 0

 $\alpha$  CORONÆ BOREALIS, 1773.1908. Aug. 7.  
G. M. T. 14<sup>h</sup> 25<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. B. CANNON

| Wt.            | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|------------------|--------------------------|------------------------------|-----------|---------------|------------------|--------------------------|------------------------------|-----------|
| 2              | 54 7903          |                          |                              |           | $\frac{1}{2}$ | 27 5854          | 27 5687                  | 0961                         | +83 41    |
| 1              | 54 0770          | 54 0281                  | 0583                         | +67 10    | 2             | 27 3236          |                          |                              |           |
| 2              | 53 1613          |                          |                              |           | $\frac{1}{2}$ | 12 0157          | 11 9397                  | 0883                         | +66 14    |
| 2              | 45 3261          |                          |                              |           | 2             | 11 5833          |                          |                              |           |
| $1\frac{1}{2}$ | 45 3538          | 45 3013                  | 0626                         | +65 35    |               |                  |                          |                              |           |

Weighted mean ..... -69 12

 $V_p$  ..... 20 91 $V_d$  ..... 19

Curvature ..... 28

Radial velocity ..... +47 7

SESSIONAL PAPER No. 25a

$\alpha$  CORONÆ BOREALIS, 1775.

1908, Aug. 7.  
G. M. T. 14<sup>h</sup> 40<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0279           |                          |                              |           | 2             | 45.3045           |                          |                              |           |
| $\frac{1}{4}$ | 72.9227           | 72.9056                  | 0.008                        | 58.20     | $\frac{1}{2}$ | 45.3313           | 45.3004                  | 0.017                        | +64.41    |
| 1             | 72.4568           |                          |                              |           | 1             | 27.5296           | 27.4692                  | 0.566                        | +49.13    |
| 2             | 54.7633           |                          |                              |           | 2             | 27.3107           |                          |                              |           |
| 1             | 54.0103           | 53.9888                  | 0.020                        | [21.87]   | 1             | 12.0051           | 11.9305                  | 0.791                        | +59.25    |
| 2             | 53.1363           |                          |                              |           | 2             | 11.5821           |                          |                              |           |

Weighted mean ..... +58.54  
 $V_a$  ..... -20.91  
 $V_d$  ..... 19  
 Curvature ..... 28  
 Radial velocity ..... +37.5

$\alpha$  CORONÆ BOREALIS, 1798.

1908, Aug. 20.  
G. M. T. 13<sup>h</sup> 05<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0365           |                          |                              |           | 2             | 53.1332           |                          |                              |           |
| $\frac{1}{2}$ | 72.8789           | 72.8528                  | 0.020                        | -17.41    | 2             | 45.2876           |                          |                              |           |
| 1             | 72.4693           |                          |                              |           | 1             | 45.2516           | 45.2376                  | 0.011                        | -1.15     |
| 2             | 54.7634           |                          |                              |           | $\frac{1}{2}$ | 27.4337           | 27.4011                  | 0.115                        | -9.98     |
| 1             | 54.0031           | 53.9821                  | 0.023                        | +14.16]   | 2             | 27.2794           |                          |                              |           |

Weighted mean ..... -7.42  
 $V_a$  ..... -20.11  
 $V_d$  ..... -16  
 Curvature ..... -28  
 Radial velocity ..... -28.0

9-10 EDWARD VII., A. 1910

 $\alpha$  CORONÆ BOREALIS, 1798\*1908, Aug. 29,  
G. M. T. 13<sup>h</sup> 05<sup>m</sup>Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73.0592           |                          |                              |           | 2   | 45.3184           |                          |                              |           |
| $\frac{1}{2}$ | 72.9039           | 72.8549                  | .0099                        | -14.36    | 1   | 45.2919           | 45.2471                  | .0084                        | + 8.76    |
| 2             | 72.4926           |                          |                              |           | 1   | 27.4682           | 27.4132                  | .0006                        | + 0.52    |
| 2             | 54.7899           |                          |                              |           | 2   | 27.3016           |                          |                              |           |
| $\frac{1}{2}$ | 54.0289           | 53.9824                  | .0126                        | + [14.50] | 1   | 11.9196           | 11.8679                  | .0165                        | + 12.36   |
| 2             | 53.1569           |                          |                              |           | 2   | 11.5585           |                          |                              |           |

Weighted mean ..... - 4.13  
 $V_a$  ..... - 20.11  
 $V_d$  ..... - .16  
 Curvature ..... - .28  
 Radial velocity ..... - 16.4

\* Check measurement.

 $\alpha$  CORONÆ BOREALIS, 1809.1908, Aug. 21,  
G. M. T. 15<sup>h</sup> 01<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0208           |                          |                              |           | 2             | 45.2855           |                          |                              |           |
| $\frac{1}{2}$ | 72.8951           | 72.8835                  | .0187                        | -27.13    | 1             | 45.2607           | 45.2488                  | .0101                        | + 10.54   |
| 1             | 72.4582           |                          |                              |           | $\frac{1}{2}$ | 27.4744           | 27.4424                  | .0298                        | + 25.87   |
| 2             | 54.7565           |                          |                              |           | 2             | 27.2787           |                          |                              |           |
| $\frac{1}{2}$ | 54.0087           | 53.9964                  | .0266                        | + [30.62] | 1             | 11.9107           | 11.8792                  | .0248                        | + 18.58   |
| 2             | 53.1219           |                          |                              |           | 2             | 11.5418           |                          |                              |           |

Weighted mean ..... + 18.54  
 $V_a$  ..... - 20.00  
 $V_d$  ..... - .25  
 Curvature ..... - .28  
 Radial velocity ..... - 2.00

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$\alpha$  CORONÆ BOREALIS, 1816.

1908, Aug. 21.  
G. M. T. 13<sup>h</sup> 12<sup>m</sup>

Observed by W. E. HARPER  
Measured by J. B. CANNON

| Wt.           | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|-------------------------|------------------------------|-----------|---------------|-------------------|-------------------------|------------------------------|-----------|
| 2             | 54 7497           |                         |                              |           | 1             | 45 2087           | 45 2922                 | 0535                         | +55 85    |
| $\frac{1}{2}$ | 54 0267           | 54 0182                 | 0084                         | - [55 71] | $\frac{1}{2}$ | 27 5152           | 27 4672                 | 0546                         | +47 38    |
| $\frac{1}{2}$ | 53 1212           |                         |                              |           | 2             | 27 2950           |                         |                              |           |
| 2             | 45 2902           |                         |                              |           |               |                   |                         |                              |           |

Weighted mean ..... +53.63  
 $V_a$  ..... -19.63  
 $V_d$  ..... -29  
 Curvature ..... -28

Radial velocity ..... + 32.9

$\alpha$  CORONÆ BOREALIS, 1817.

1908, Aug. 24.  
G. M. T. 13<sup>h</sup> 27<sup>m</sup>

Observed by W. E. HARPER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|-------------------------|------------------------------|-----------|---------------|-------------------|-------------------------|------------------------------|-----------|
| 1             | 73 0283           |                         |                              |           | 2             | 45 2794           |                         |                              |           |
| $\frac{1}{2}$ | 72 9461           | 72 9283                 | 0635                         | +92 13    | 1             | 45 2977           | 45 2920                 | 0533                         | +55 64    |
| 1             | 72 4579           |                         |                              |           | $\frac{1}{2}$ | 27 5221           | 27 5085                 | 0959                         | +83 24    |
| 2             | 54 7488           |                         |                              |           | 2             | 27 2603           |                         |                              |           |
| 1             | 54 0279           | 54 0227                 | 0529                         | + [62 66] | $\frac{1}{2}$ | 11 9477           | 11 9257                 | 0743                         | +55 65    |
| 2             | 53 1145           |                         |                              |           | 2             | 11 5295           |                         |                              |           |

Weighted mean ..... +68.45  
 $V_a$  ..... -19.63  
 $V_d$  ..... -20  
 Curvature ..... -28

Radial velocity ..... + 48.3

$\alpha$  CORONÆ BOREALIS, 1827.

1908, Aug. 25.  
G. M. T. 13<sup>h</sup>

Observed by J. B. CANNON  
Measured by J. B. CANNON

| Wt. | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|-----|-------------------|-------------------------|------------------------------|-----------|---------------|-------------------|-------------------------|------------------------------|-----------|
| 2   | 54 6765           |                         |                              |           | 1             | 45 2167           | 45 2857                 | 0470                         | +49 06    |
| 1   | 53 9543           | 54 0213                 | 0515                         | + [59 28] | $\frac{1}{2}$ | 27 4307           | 27 4547                 | 0421                         | +36 54    |
| 2   | 53 0434           |                         |                              |           | 2             | 27 2226           |                         |                              |           |
| 2   | 45 2046           |                         |                              |           |               |                   |                         |                              |           |

Weighted mean ..... +46.56  
 $V_a$  ..... -19.51  
 $V_d$  ..... -17  
 Curvature ..... -28

Radial velocity ..... + 26.6

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## α CORONÆ BOREALIS, 1836.

1908. Aug. 27.  
G. M. T. 14<sup>h</sup> 34Observed by J. B. CANNON  
Measured by J. B. CANNON

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|-----------|
| 1             | 73 0226          |                         |                              |           | 2             | 45 2911          |                         |                              |           |
| $\frac{1}{2}$ | 72 8809          | 72 8770                 | 0122                         | 17 70     | 1             | 45 2916          | 45 2741                 | 0354                         | -36 95    |
| 1             | 72 4579          |                         |                              |           | $\frac{1}{2}$ | 27 4900          | 27 4623                 | 0497                         | +43 13    |
| 2             | 54 7549          |                         |                              |           | 2             | 27 2740          |                         |                              |           |
| 1             | 53 9889          | 53 9763                 | 0065                         | -[ 7 48]  | $\frac{1}{2}$ | 11 9036          | 11 8701                 | 0187                         | +14 00    |
| 2             | 53 1241          |                         |                              |           | 2             | 11 5409          |                         |                              |           |

Weighted mean..... -29 74  
 $V_a$ ..... 19 21  
 $V_d$ ..... 28  
 Curvature..... 28

Radial velocity ..... + 10 0

## α CORONÆ BOREALIS, 1841.

1908. Aug. 28.  
G. M. T. 13<sup>h</sup>Observed by J. B. CANNON  
Measured by J. B. CANNON

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|-----------|
| 1             | 73 0259          |                         |                              |           | $\frac{1}{2}$ | 27 5064          | 27 4684                 | 0558                         | +48 43    |
| $\frac{1}{2}$ | 72 8870          | 72 8701                 | 0053                         | + 7 69    | 2             | 27 2849          |                         |                              |           |
| 1             | 72 4641          |                         |                              |           | 1             | 11 9382          | 11 8832                 | 0318                         | -23 82    |
| 2             | 45 2921          |                         |                              |           | 2             | 11 5626          |                         |                              |           |
| 1             | 45 2848          | 45 2663                 | 0276                         | +28 81    |               |                  |                         |                              |           |

Weighted mean..... -24 94  
 $V_a$ ..... 19 03  
 $V_d$ ..... 19  
 Curvature..... 28

Radial velocity ..... + 5 4



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$\alpha$  CORONÆ BOREALIS, 1842.

1908, Aug. 28.  
G. M. T. 13<sup>h</sup> 14<sup>m</sup>

Observed by J. B. CANNON  
Measured by J. B. CANNON

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1               | 73.0092           |                          |                              |           | 2   | 45.2878           |                          |                              |           |
| 1               | 72.8733           | 72.8738                  | 0090                         | 13.06     | 1   | 45.2838           | 45.2696                  | 0309                         | +32.26    |
| 1               | 72.4448           |                          |                              |           | 1   | 27.4705           | 27.4112                  | 0286                         | +24.82    |
| 2               | 51.7462           |                          |                              |           | 2   | 27.2762           |                          |                              |           |
| 1               | 54.0117           | 54.0051                  | 0353                         | + [39.63] | 1   | 11.9601           | 11.9223                  | 0709                         | +53.10    |
| 2               | 53.1214           |                          |                              |           | 2   | 11.5452           |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | 30.60     |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | 19.03     |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | 20        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | 11.1      |

$\alpha$  CORONÆ BOREALIS, 1852.

1908, Aug. 31.  
G. M. T. 13<sup>h</sup> 17<sup>m</sup>

Observed by W. F. HARPER.  
Measured by J. B. CANNON.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1               | 73.0311           |                          |                              |           | 1   | 27.4462           | 27.4123                  | 0297                         | +25.78    |
| 1/2             | 72.8743           | 72.8536                  | 0112                         | 12.89     | 2   | 27.2515           |                          |                              |           |
| 1               | 72.4637           |                          |                              |           | 1   | 11.8686           | 11.8702                  | 0188                         | +14.08    |
| 2               | 45.2785           |                          |                              |           | 2   | 11.5056           |                          |                              |           |
| 1 1/2           | 45.2366           | 45.2317                  | 0070                         | - 7.31    |     |                   |                          |                              |           |
| Weighted mean   |                   |                          |                              |           |     |                   |                          |                              | 3.66      |
| $V_a$           |                   |                          |                              |           |     |                   |                          |                              | 18.53     |
| $V_d$           |                   |                          |                              |           |     |                   |                          |                              | 22        |
| Curvature       |                   |                          |                              |           |     |                   |                          |                              | 28        |
| Radial velocity |                   |                          |                              |           |     |                   |                          |                              | - 15.4    |

9-10 EDWARD VII., A. 1910

 $\alpha$  CORONÆ BOREALIS, 1852\*.1908, Aug. 31.  
G. M. T. 13<sup>h</sup> 17<sup>m</sup>Observed by W. E. HARPER,  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0047           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 27.4278           | 27.4397                  | .0271                        | +23.52    |
| $\frac{1}{2}$ | 72.8550           | 72.8598                  | .0050                        | - 7.25    | 2             | 27.2347           | .....                    | .....                        | .....     |
| 1             | 72.4409           | .....                    | .....                        | .....     | $\frac{1}{4}$ | 11.8520           | 11.8750                  | .0236                        | +17.68    |
| 2             | 45.2570           | .....                    | .....                        | .....     | 2             | 11.4840           | .....                    | .....                        | .....     |
| 1             | 45.2188           | 45.2354                  | .0033                        | - 3.45    | .....         | .....             | .....                    | .....                        | .....     |

Weighted mean ..... - 4.05  
 $V_a$  ..... - 18.53  
 $V_d$  ..... - .22  
 Curvature ..... - .28

Radial velocity ..... - 15.0

\* Check Measurement

 $\alpha$  CORONÆ BOREALIS, 1861.1908, Sept. 3.  
G. M. T. 12<sup>h</sup> 50<sup>m</sup>Observed by J. S. PLASKETT,  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 1             | 73.0328           | .....                    | .....                        | .....     | $\frac{1}{2}$ | 27.4429           | 27.4029                  | .0097                        | - 8.42    |
| $\frac{1}{2}$ | 72.8769           | 72.8535                  | .0113                        | - 16.40   | 2             | 27.2866           | .....                    | .....                        | .....     |
| 1             | 72.4697           | .....                    | .....                        | .....     | 1             | 11.8911           | 11.8395                  | .0119                        | - 8.91    |
| 2             | 45.2913           | .....                    | .....                        | .....     | 2             | 11.5592           | .....                    | .....                        | .....     |
| 1             | 45.2442           | 45.2265                  | .0122                        | - 12.74   | .....         | .....             | .....                    | .....                        | .....     |

Weighted mean ..... - 11.35  
 $V_a$  ..... - 18.03  
 $V_d$  ..... - .21  
 Curvature ..... - .28

Radial velocity ..... - 29.9

SESSIONAL PAPER No. 25a

$\alpha$  CORONÆ BOREALIS, 1865.

1908, Sept. 4,  
G. M. T. 13<sup>h</sup> 27<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|-----------|
| 1             | 73 0201          |                         |                              |           | 2             | 45 2962          |                         |                              |           |
| $\frac{1}{2}$ | 72 8801          | 72 8693                 | 0015                         | + 6 53    | 1             | 45 2687          | 45 2461                 | 0074                         | + 7 73    |
| 1             | 72 4571          |                         |                              |           | $\frac{1}{4}$ | 27 4456          | 27 3976                 | 0150                         | - 10 02   |
| 2             | 54 7639          |                         |                              |           | 2             | 27 2949          |                         |                              |           |
| 1             | 53 9634          | 53 9411                 | 0287                         | - [33 03] | $\frac{1}{4}$ | 11 9038          | 11 8461                 | 0053                         | - 3 97    |
| 2             | 53 1346          |                         |                              |           | 2             | 11 5651          |                         |                              |           |

Weighted mean ..... + 3 75  
 $V_a$  ..... - 17 87  
 $V_d$  ..... - 27  
 Curvature ..... - 28

Radial velocity ..... - 14 7

$\alpha$  CORONÆ BOREALIS, 1882.

1908, Sept. 14,  
G. M. T. 12<sup>h</sup> 51<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|----------|
| 1             | 73 0319          |                         |                              |           | 2             | 45 3247          |                         |                              |          |
| $\frac{1}{2}$ | 72 9083          | 72 8867                 | 0219                         | + 31 78   | 1             | 45 3219          | 45 2708                 | 0321                         | + 33 51  |
| 1             | 72 4692          |                         |                              |           | $\frac{1}{2}$ | 27 3253          | 27 4463                 | 0337                         | + 29 25  |
| 2             | 54 7787          |                         |                              |           | 2             | 27 3257          |                         |                              |          |
| $\frac{1}{4}$ | 54 0006          | 53 9646                 | 0052                         | - [ 5 99] | $\frac{1}{2}$ | 12 0035          | 11 8975                 | 0451                         | + 33 78  |
| 2             | 53 1472          |                         |                              |           | 2             | 11 6135          |                         |                              |          |

Weighted mean ..... + 32 77  
 $V_a$  ..... - 15 95  
 $V_d$  ..... - 23  
 Curvature ..... - 28

Radial velocity ..... + 16 3

9-10 EDWARD VII., A. 1910

 $\alpha$  CORONÆ BOREALIS, 1883.1908. Sept. 14.  
G. M. T. 13<sup>h</sup> 05<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|-----------|
| $\frac{2}{3}$ | 54 7551          |                         |                              |           | 2             | 27 2799          |                         |                              |           |
| $\frac{2}{3}$ | 54 0166          | 54 0060                 | 0362                         | + [40 57] | $\frac{1}{2}$ | 15 5465          | 15 4985                 | 0252                         | + 19 50   |
| $\frac{2}{3}$ | 53 1201          |                         |                              |           | 2             | 15 4467          |                         |                              |           |
| $\frac{2}{3}$ | 45 2864          |                         |                              |           | 1             | 11 9188          | 11 8737                 | 0223                         | + 16 70   |
| 1             | 45 2824          | 45 2696                 | 0309                         | - 32 26   | 2             | 11 5523          |                         |                              |           |
| $\frac{1}{2}$ | 27 4653          | 27 4323                 | 0197                         | - 17 10   |               |                  |                         |                              |           |

Weighted mean ..... + 22 85  
 $V_a$  ..... - 15 95  
 $V_d$  ..... - 23  
 Curvature ..... - 28

Radial velocity ..... + 6 4

 $\alpha$  CORONÆ BOREALIS, 1894.1908. Sept. 19.  
G. M. T. 12<sup>h</sup> 02<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings | Corrected Star Settings | Displacement in Revolutions. | Velocity. |
|---------------|------------------|-------------------------|------------------------------|-----------|---------------|------------------|-------------------------|------------------------------|-----------|
| $\frac{2}{3}$ | 73 0180          |                         |                              |           | 2             | 45 3163          |                         |                              |           |
| $\frac{2}{3}$ | 72 8619          | 72 8515                 | 0133                         | - 19 30   | $\frac{1}{2}$ | 45 2773          | 45 2346                 | 0041                         | - 4 28    |
| $\frac{2}{3}$ | 72 4620          |                         |                              |           | $\frac{1}{2}$ | 27 4673          | 27 4000                 | 0126                         | - 10 94   |
| $\frac{2}{3}$ | 54 7725          |                         |                              |           | 2             | 27 3142          |                         |                              |           |
| $\frac{1}{2}$ | 53 9865          | 53 9545                 | 0153                         | - [17 51] | $\frac{1}{2}$ | 11 9190          | 11 8336                 | 0178                         | - 13 33   |
| 2             | 53 1454          |                         |                              |           | 2             | 11 5926          |                         |                              |           |

Weighted mean ..... - 11 96  
 $V_a$  ..... - 14 58  
 $V_d$  ..... - 22  
 Curvature ..... - 28

Radial velocity ..... - 27 0

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$\alpha$  CORONÆ BOREALIS, 1895.

1908. Sept. 19.  
G. M. T. 12<sup>h</sup> 17<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0038           |                          |                              |           | 2              | 45 2814           |                          |                              |           |
| $\frac{1}{2}$ | 72 8573           | 72 8633                  | 0015                         | -2 18     | 1              | 45 2429           | 45 2351                  | 0036                         | -3 76     |
| 2             | 72 4388           |                          |                              |           | $\frac{1}{2}$  | 27 4293           | 27 4118                  | 0008                         | -0 69     |
| 2             | 54 7388           |                          |                              |           | 2              | 27 2643           |                          |                              |           |
| $\frac{1}{2}$ | 53 9565           | 54 9580                  | 0018                         | -[13 58]  | $1\frac{1}{2}$ | 11 8895           | 11 8595                  | 0081                         | +6 07     |
| 2             | 53 1120           |                          |                              |           | 2              | 11 5373           |                          |                              |           |

Weighted mean . . . . . + 1 26  
 $V_a$  . . . . . -14 58  
 $V_d$  . . . . . - 22  
 Curvature . . . . . - 28

Radial velocity . . . . . -13 8

$\alpha$  CORONÆ BOREALIS, 1896.

1908. Sept. 19.  
G. M. T. 12<sup>h</sup> 30<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 54 7526           |                          |                              |           | $1\frac{1}{2}$ | 45 2619           | 45 2371                  | 0016                         | -1 67     |
| $\frac{1}{2}$ | 53 9992           | 53 9889                  | 0191                         | -[21 98]  | 1              | 27 4389           | 27 3969                  | 0157                         | -13 63    |
| 2             | 53 1219           |                          |                              |           | 2              | 27 2889           |                          |                              |           |
| 2             | 45 2984           |                          |                              |           |                |                   |                          |                              |           |

Weighted mean . . . . . -6 26  
 $V_a$  . . . . . -14 58  
 $V_d$  . . . . . - 22  
 Curvature . . . . . - 28

Radial velocity . . . . . -21 3

$\alpha$  CORONÆ BOREALIS, 1897.

1908. Sept. 19.  
G. M. T. 12<sup>h</sup> 42<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 73 0197           |                          |                              |           | 2              | 45 3094           |                          |                              |           |
| $\frac{1}{2}$ | 72 8669           | 11 8573                  | 0075                         | -10 88    | $1\frac{1}{2}$ | 45 2797           | 45 2439                  | 0052                         | +5 43     |
| 2             | 72 4537           |                          |                              |           | 1              | 27 4750           | 27 4097                  | 0029                         | -2 52     |
| 2             | 54 7572           |                          |                              |           | 2              | 27 3122           |                          |                              |           |
| $\frac{1}{2}$ | 53 9924           | 53 9731                  | 0033                         | + [3 80]  | 1              | 11 9309           | 11 8492                  | 0022                         | -1 65     |
| 2             | 53 1352           |                          |                              |           | 2              | 11 5892           |                          |                              |           |

Weighted mean . . . . . -0 37  
 $V_a$  . . . . . -14 58  
 $V_d$  . . . . . - 22  
 Curvature . . . . . - 28

Radial velocity . . . . . -15 5

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## α CORONÆ BOREALIS, 1949.

1908. Nov. 1.  
G. M. T. 10<sup>h</sup> 41<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 1             | 72 9672           |                          |                              |           | 1   | 45 3692           |                          |                              |           |
| $\frac{1}{4}$ | 72 8800           | 72 9220                  | 0572                         | -82.99    | 1   | 45 2928           | 45 2928                  | 0185                         | +19.31    |
| 1             | 54 7598           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean . . . . . +39.88  
 $V_a$  . . . . . - 38  
 $V_d$  . . . . . - 27  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -38.9

## α CORONÆ BOREALIS, 1950.

1908. Nov. 1.  
G. M. T. 10<sup>h</sup> 58<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 48 7674           |                          |                              |           | 2             | 27 3286           |                          |                              |           |
| 1             | 45 3178           | 45 3118                  | 0631                         | +65.87    | $\frac{1}{4}$ | 12 0368           | 11 9236                  | 0722                         | -54.07    |
| $\frac{1}{4}$ | 27 5393           | 27 4850                  | 0724                         | -62.84    | 1             | 11 6326           |                          |                              |           |

Weighted mean . . . . . +63.40  
 $V_a$  . . . . . - 38  
 $V_d$  . . . . . - 27  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -62.5

## α CORONÆ BOREALIS, 1951.

1908. Nov. 1.  
G. M. T. 11<sup>h</sup> 14<sup>m</sup>Observed by J. B. CANNON.  
Measured by J. B. CANNON.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 45 3028           |                          |                              |           | 1   | 45 3170           | 45 2878                  | 0491                         | +51.26    |

Velocity . . . . . +51.26  
 $V_a$  . . . . . - 38  
 $V_d$  . . . . . - 27  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -50.3

SESSIONAL PAPER No. 25a

OBSERVING RECORD AND DETAILED MEASURES OF δ AQUILÆ.

P. — PLASKETT,  
H. — HARPER,  
C. — CANNON,  
PL. — PARKER,  
T. — TRIBLE.

RECORD OF SPECTROGRAMS.

| STAR.     | No. of Negative. | Camera. | Plate.  | Date.   | Middle of Exposure.<br>G. M. T. |       | Duration. | Hour<br>Angle<br>at end. | TEMPERATURE. |           |            |              | Seeing.         | Observer. |
|-----------|------------------|---------|---------|---------|---------------------------------|-------|-----------|--------------------------|--------------|-----------|------------|--------------|-----------------|-----------|
|           |                  |         |         |         |                                 |       |           |                          | Room.        |           | Prism Box. |              |                 |           |
|           |                  |         |         |         |                                 |       |           |                          | Beg.         | End.      | Beg.       | End.         |                 |           |
|           |                  |         |         | 1906.   | h. m.                           | m.    | h. m.     | Fahrenheit.              | Centigrade.  |           |            |              |                 |           |
| δ Aquilæ. | 368              | ..      | Seed 27 | Aug.    | 6 17                            | 35 85 | 2 55W.    | 71 0                     | 69 4         | 27 7 28 0 | 001        | Good         | H               |           |
| "         | 377              | ..      | " R     | "       | 15 15                           | 40 70 | 1 07W.    | 68 2                     | 66 0         | 25 6 25 6 | 001        | "            | H               |           |
| "         | 382              | ..      | "       | "       | 24 15                           | 45 90 | 2 15W.    | 64 0                     | 62 1         | 22 8 22 9 | 001        | Fair         | H               |           |
| "         | 390              | ..      | "       | Sept.   | 10 15                           | 30 60 | 2 50W.    | 69 0                     | 67 0         | 26 7 26 7 | 001        | Good         | H               |           |
| "         | 399              | ..      | "       | "       | 27 14                           | 45 60 | 3 15W.    | 60 0                     | 59 6         | 21 8 21 8 | 001        | "            | H               |           |
| "         | 413              | ..      | "       | 27 Oct. | 23 13                           | 45 90 | 4 10W.    | 50 3                     | 46 2         | 15 1 15 3 | 001        | Dancing      | H               |           |
|           |                  |         |         | 1907.   |                                 |       |           | Centigrade.              |              |           |            |              |                 |           |
| "         | 803              | IL      | "       | May     | 31 19                           | 04 25 | 35E.      | 12 6                     | 12 6         | 18 7 18 7 | 001        | Good         | P               |           |
| "         | 818              | "       | "       | June    | 10 19                           | 13 20 | 15W.      | 12 4                     | 12 1         | 17 8 17 8 | 0012       | "            | P               |           |
| "         | 904              | "       | "       | July    | 2 18                            | 12 24 | 40W.      | 13 5                     | 14 0         | 17 0 17 0 | 0014       | "            | H               |           |
| "         | 923              | "       | "       | "       | 8 18                            | 02 25 | 55W.      | 20 2                     | 20 1         | 22 3 22 2 | 0012       | Poor to fair | P               |           |
| "         | 930              | "       | "       | "       | 9 16                            | 33 30 | 30E.      | 21 5                     | 20 9         | 25 0 25 0 | 0012       | Good         | H               |           |
| "         | 938              | "       | "       | "       | 10 16                           | 30 30 | 28E.      | 22 6                     | 22 4         | 24 5 24 5 | 0012       | Fair to poor | P               |           |
| "         | 966              | "       | "       | "       | 25 16                           | 30 60 | 48W.      | 21 5                     | 21 5         | 28 0 27 8 | 0014       | Poor         | H               |           |
| "         | 980              | "       | "       | Aug.    | 3 14                            | 40 30 | 45E.      | 19 5                     | 19 5         | 24 0 24 1 | 0012       | "            | P               |           |
| "         | 982              | "       | "       | "       | 5 16                            | 35 28 | 1 10W.    | 17 6                     | 17 6         | 21 0 21 0 | 0012       | Fair to poor | P               |           |
| "         | 1034             | "       | "       | Sept.   | 6 15                            | 44 41 | 2 35W.    | 18 3                     | 18 0         | 21 0 20 5 | 0012       | Fair         | T               |           |
| "         | 1049             | "       | "       | "       | 18 13                           | 56 47 | 1 42W.    | 14 0                     | 12 5         | 17 1 17 1 | 0014       | "            | T               |           |
|           |                  |         |         | 1908.   |                                 |       |           |                          |              |           |            |              |                 |           |
| "         | 1543             | "       | "       | May     | 18 20                           | 06 30 | 0 00      | 15 5                     | 15 0         | 23 4 23 4 | 0016       | Hazy         | H               |           |
| "         | 1550             | "       | "       | "       | 22 20                           | 34 42 | 39W.      | 19 0                     | 19 0         | 25 0 25 0 | 0017       | Fair         | H               |           |
| "         | 1575             | "       | "       | June    | 3 20                            | 01 40 | 45W.      | 13 0                     | 12 5         | 18 3 18 3 | 0015       | "            | H               |           |
| "         | 1584             | "       | "       | "       | 5 20                            | 35 40 | 1 30W.    | 14 0                     | 14 3         | 24 4 24 4 | 0016       | Not good     | P <sup>1</sup>  |           |
| "         | 1633             | "       | "       | "       | 24 18                           | 31 37 | 40W.      | 19 0                     | 19 0         | 27 5 27 5 | 0015       | Good         | H               |           |
| "         | 1642             | "       | "       | "       | 26 18                           | 52 55 | 1 20W.    | 17 6                     | 17 5         | 30 2 30 0 | 0016       | "            | P <sup>1</sup>  |           |
| "         | 1650             | "       | "       | "       | 27 18                           | 09 35 | 30W.      | 19 5                     | 19 1         | 23 6 23 4 | 0014       | "            | P               |           |
| "         | 1660             | "       | "       | July    | 3 18                            | 35 50 | 25W.      | 20 5                     | 20 1         | 25 1 25 1 | 0016       | Fair         | HP <sup>1</sup> |           |
| "         | 1678             | "       | "       | "       | 8 18                            | 10 40 | 1 15W.    | 17 0                     | 17 5         | 21 6 21 6 | 0015       | Good         | C-H             |           |
| "         | 1690             | "       | "       | "       | 10 18                           | 33 45 | 1 55W.    | 21 1                     | 20 5         | 27 5 28 0 | 0016       | "            | P <sup>1</sup>  |           |
| "         | 1695             | "       | "       | "       | 11 18                           | 27 35 | 1 45W.    | 26 0                     | 25 4         | 29 8 29 7 | 0015       | Fair         | P               |           |
| "         | 1703             | "       | "       | "       | 13 18                           | 52 45 | 2 25W.    | 18 2                     | 18 0         | 23 0 23 0 | 0015       | Good         | P <sup>1</sup>  |           |
| "         | 1753             | "       | "       | "       | 31 16                           | 41 32 | 1 10W.    | 19 5                     | 19 5         | 26 0 25 9 | 0015       | "            | P <sup>1</sup>  |           |
| "         | 1754             | "       | "       | "       | 31 17                           | 17 34 | 1 48W.    | 19 5                     | 19 0         | 25 9 25 6 | 0015       | "            | H               |           |
| "         | 1768             | "       | "       | Aug.    | 5 18                            | 05 40 | 2 55W.    | 20 8                     | 20 5         | 26 7 26 5 | 0015       | "            | P-C             |           |
| "         | 1783             | "       | "       | "       | 15 17                           | 38 30 | 3 05W.    | 18 0                     | 17 6         | 22 5 22 4 | 0015       | Fair         | P               |           |
| "         | 1837             | "       | "       | "       | 27 15                           | 03 35 | 1 20W.    | 18 0                     | 17 0         | 23 2 23 0 | 0015       | Good         | C               |           |

1906. Aug. 6.  
G. M. T. 17° 35'

δ AQUILÆ 368.

Observed by W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|-----|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 3   | S 68° 37.90       | 4528.798               |                         |                      |               |           |
| 3   | 65° 35.12         | 4494.626               |                         | 738                  |               |           |
| 1   | 64° 11.76         | 4480.972               | 000                     | 400                  | 400           | -26.76    |
| 2   | 63° 66.77         | 4476.194               |                         | 185                  |               |           |
| 2   | 62° 79.48         | 4466.791               |                         | 727                  |               |           |
| ½   | 61° 59.39         | 4454.023               | 973                     | 552                  | 579           | 39.63     |
| 3   | S 56° 80.11       | 4404.927               |                         |                      |               |           |
| 2   | 54° 64.45         | 4383.756               |                         | 720                  |               |           |
| 3   | 50° 02.85         | 4340.237               | 184                     | 634                  | 450           | 31.05     |
| 3   | 48° 46.14         | 4325.992               |                         | 939                  |               |           |
| 3   | S 46° 45.00       | 4308.081               |                         |                      |               |           |
| 1   | 45° 41.72         | 4299.044               |                         | 674                  |               |           |
| 3   | 44° 86.05         | 4294.217               |                         | 301                  |               |           |
| 2   | 44° 32.48         | 4289.601               | 642                     | 632                  | 390           | -27.22    |

Weighted mean ..... - 31.16  
*V<sub>a</sub>* ..... - 10.00  
*V<sub>d</sub>* ..... - 16  
 Curvature ..... - 50  
 Radial velocity ..... - 41.8

1906. Aug. 15.  
G. M. T. 15° 40'

δ AQUILÆ 377.

Observed by W. E. HARPER.  
Measured by J.

| Wt. | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|-----|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 2   | S 70° 19.69       | 4549.642               |                         |                      |               |           |
| 2   | 70° 14.60         | 4549.039               | 039                     | 642                  | 603           | -39.73    |
| ½   | 68° 84.03         | 4533.723               | 753                     | 168                  | 415           | 27.43     |
| 3   | 68° 41.18         | 4528.757               |                         | 798                  |               |           |
| 2   | 65° 40.82         | 4494.722               |                         | 738                  |               |           |
| 2   | 64° 16.38         | 4481.013               | 953                     | 400                  | 447           | 29.90     |
| 2   | 63° 72.91         | 4476.277               |                         | 185                  |               |           |
| ½   | 63° 07.06         | 4469.152               | 062                     | 545                  | 485           | 32.36     |
| 2   | 62° 85.51         | 4466.835               |                         | 727                  |               |           |
| ½   | 58° 14.12         | 4417.700               | 670                     | 638                  | 368           | 24.95     |
| 3   | S 56° 86.82       | 4404.927               |                         |                      |               |           |
| 2   | 54° 69.73         | 4383.606               |                         | 720                  |               |           |
| 3   | 50° 08.13         | 4340.115               | 184                     | 634                  | 450           | 31.05     |
| 3   | 48° 51.81         | 4325.926               |                         | 939                  |               |           |
| 3   | S 46° 51.00       | 4308.081               |                         |                      |               |           |
| 2   | 44° 93.17         | 4294.348               |                         | 301                  |               |           |
| 1   | 44° 90.73         | 4294.138               |                         | 301                  |               |           |
| 1   | 44° 38.30         | 4289.632               | 590                     | 632                  | 442           | -30.85    |

Weighted mean ..... - 30.89  
*V<sub>a</sub>* ..... - 13.62  
*V<sub>d</sub>* ..... - 19  
 Curvature ..... - 50  
 Radial velocity ..... - 45.2



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δ AQUILÆ 382.

1906, Aug. 24,  
G. M. T. 15<sup>h</sup> 15<sup>m</sup>

Observed by W. E. HARPER.  
Measured by )

| Wt. | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths | Displacement. | Velocity. |
|-----|-------------------|------------------------|-------------------------|---------------------|---------------|-----------|
| 2   | 76 1122           | 4549 520               | .....                   | 642                 | .....         | .....     |
| 1   | 70 1029           | 4549 410               | 360                     | 905                 | 375           | 24 71     |
| 3   | Σ 68 3400         | 4528 798               | .....                   | .....               | .....         | .....     |
| 1   | 67 7987           | 4522 566               | 558                     | 855                 | 297           | 19 69     |
| 1   | 65 9371           | 4501 472               | .....                   | 505                 | .....         | .....     |
| 2   | 65 3329           | 4494 735               | .....                   | 738                 | .....         | .....     |
| 1   | 64 0791           | 4480 926               | 930                     | 400                 | 470           | 31 44     |
| 2   | 63 6431           | 4476 176               | .....                   | 185                 | .....         | .....     |
| 2   | 62 7647           | 4466 688               | .....                   | 727                 | .....         | .....     |
| 1   | 59 7630           | 4435 058               | 078                     | 450                 | 372           | 25 14     |
| 2   | Σ 56 7937         | 4404 927               | .....                   | .....               | .....         | .....     |
| 1   | 56 3165           | 4400 188               | 188                     | 738                 | 550           | 37 45     |
| 1   | 55 7715           | 4394 808               | 804                     | 286                 | 482           | 32 87     |
| 2   | 54 6357           | 4383 715               | .....                   | 720                 | .....         | .....     |
| 2   | 53 7124           | 4374 809               | 821                     | 103                 | 282           | 19 31     |
| 2   | 50 0145           | 4340 120               | 134                     | 634                 | 500           | 34 50     |
| 2   | 48 4534           | 4325 930               | .....                   | 939                 | .....         | .....     |
| 1   | 47 9225           | 4321 161               | .....                   | .....               | .....         | .....     |
| 2   | Σ 46 4482         | 4308 081               | 164                     | .....               | .....         | .....     |
| 2   | 44 8650           | 4294 280               | .....                   | 301                 | .....         | .....     |
| 2   | 44 8327           | 4291 002               | 018                     | 301                 | 283           | 19 78     |
| 2   | 44 3189           | 4289 578               | 596                     | 032                 | 436           | -30 52    |

Weighted mean ..... -27 54  
 $V_a$  ..... -16 98  
 $V_d$  ..... .12  
 Curvature ..... 50  
 Radial velocity ..... 45 1

δ AQUILÆ 390.

1906, Sept. 10,  
G. M. T. 15<sup>h</sup> 30<sup>m</sup>

Observed by W. E. HARPER.  
Measured by )

| Wt. | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|-----|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 1   | 65 2901           | 4494 811               | .....                   | 738                  | .....         | .....     |
| 1   | 64 0719           | 4481 396               | 360                     | 400                  | 040           | - 2 67    |
| 1   | 63 6037           | 4476 296               | .....                   | 185                  | .....         | .....     |
| 2   | 54 5817           | 4383 730               | .....                   | 720                  | .....         | .....     |
| 2   | 49 9026           | 4339 632               | 620                     | 640                  | 020           | - 1 38    |
| 3   | 48 3953           | 4325 945               | .....                   | 939                  | .....         | .....     |

Weighted mean ..... - 2 00  
 $V_a$  ..... -22 26  
 $V_d$  ..... - 19  
 Curvature ..... - 28  
 Radial velocity ..... - 25 0

9-10 EDWARD VII., A. 1910

♂ AQUILE 399.

1906, Sept. 27.  
G. M. T. 14<sup>h</sup> 45<sup>m</sup>Observed by W. E. HARPER.  
Measured by f

| Wt.           | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|---------------|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 3             | 70 1090           | 4549 618               |                         | 642                  |               |           |
| 1             | 68 7306           | 4533 425               | 432                     | 419                  | 013           | + 6.85    |
|               | 5 68 3316         | 4528 798               |                         |                      |               |           |
| 3             | 65 3312           | 4494 755               |                         | 738                  |               |           |
| 2             | 64 7742           | 4488 581               | 573                     | 495                  | 078           | + 5.21    |
| 1             | 64 1215           | 4481 495               | 495                     | 400                  | 005           | + 0.33    |
| 3             | 63 6427           | 4476 178               |                         | 185                  |               |           |
| 3             | 62 7675           | 4466 710               |                         | 727                  |               |           |
| 1             | 62 3372           | 4462 093               | 199                     | 165                  | 056           | - 3.75    |
| 2             | 62 0765           | 4459 309               |                         | 501                  |               |           |
| 1             | 61 1665           | 4449 662               | 676                     | 785                  | 109           | - 7.33    |
| 1             | 58 0743           | 4417 705               | 695                     | 884                  | 189           | - 12.81   |
|               | 5 56 8037         | 4404 927               |                         |                      |               |           |
| 1             | 55 8229           | 4395 202               | 210                     | 201                  | 009           | + 0.61    |
| 1             | 54 6149           | 4383 677               |                         | 720                  |               |           |
| 1             | 53 6987           | 4370 905               |                         | 114                  |               |           |
| 2             | 50 0504           | 4340 559               | 564                     | 634                  | 070           | - 4.83    |
| 2             | 48 4750           | 4325 930               |                         | 939                  |               |           |
|               | 5 46 4725         | 4308 081               |                         |                      |               |           |
| 2             | 44 8977           | 4294 319               |                         | 301                  |               |           |
| 2             | 44 3930           | 4289 984               | 964                     | 032                  | 068           | - 4.75    |
| $\frac{1}{2}$ | 42 1961           | 4271 329               | 305                     | 325                  | 020           | - 1.40    |

Weighted mean ..... - 2.68  
 $V_a$  ..... - 25.74  
 $V_d$  ..... - .22  
Curvature ..... - .50  
Radial velocity ..... - 29.0

1906, Oct. 23.  
G. M. T. 13<sup>h</sup> 45<sup>m</sup>

♂ AQUILE 413.

Observed by W. E. HARPER.  
Measured by f

| Wt.           | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|---------------|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 1             | 70 1315           | 4549 642               | 642                     | 642                  | 000           | 0.00      |
| 1             | 5 70 1315         | 4549 642               |                         |                      |               |           |
| 2             | 68 3595           | 4528 840               |                         | 798                  |               |           |
| 1             | 65 3580           | 4494 715               |                         | 738                  |               |           |
| 2             | 64 1318           | 4481 159               | 190                     | 400                  | 210           | - 14.04   |
| 1             | 63 6731           | 4476 145               |                         | 185                  |               |           |
| 3             | 5 56 8482         | 4404 927               |                         |                      |               |           |
| 2             | 54 6954           | 4383 707               |                         | 720                  |               |           |
| 1             | 53 7352           | 4374 423               | 439                     | 628                  | 189           | - 12.94   |
| 1             | 50 1309           | 4340 528               | 540                     | 640                  | 100           | - 6.90    |
| 3             | 48 5299           | 4325 938               |                         | 939                  |               |           |
| 3             | 5 46 5280         | 4308 081               |                         |                      |               |           |
| $\frac{1}{2}$ | 46 4975           | 4307 813               | 813                     | 023                  | 210           | - 14.61   |

Weighted mean ..... - 10.04  
 $V_a$  ..... - 26.88  
 $V_d$  ..... - .25  
Curvature ..... - .50  
Radial velocity ..... - 37.7

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δ AQUILÆ 803.

1907. May 31.  
G. M. T. 19<sup>h</sup> 04<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.8154           |                          |                              |           | 1   | 45.9607           | 9592                     | 0280                         | 29.45     |
| 1   | 57.7707           | 7847                     | 0421                         | -50.68    | 2   | 45.2762           |                          |                              |           |
| 2   | 54.7232           |                          |                              |           | 1   | 45.1958           | 1938                     | 0449                         | 46.87     |
| 1   | 53.9416           | 9516                     | 0182                         | 20.94     | 2   | 43.5392           |                          |                              |           |
| 2   | 53.1061           |                          |                              |           | 2   | 37.9741           |                          |                              |           |
| 2   | 48.7682           |                          |                              |           | 1   | 37.2332           | 2192                     | 0696                         | 66.73     |
| 1   | 48.6938           | 6958                     | 0682                         | 75.33     | 1   | 27.3962           | 3422                     | 0704                         | -61.10    |
| 1   | 47.4378           | 4383                     | 0321                         | 34.34     | 2   | 27.2954           |                          |                              |           |

Weighted mean ..... - 47.92  
 $V_a$  ..... +18.24  
 $V_d$  ..... +.07  
 Curvature ..... - .28  
 Radial velocity ..... - 29.9

δ AQUILÆ 818.

1907. June 10.  
G. M. T. 19<sup>h</sup> 13<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.8253           |                          |                              |           | 1   | 45.9704           | 9304                     | 0568                         | 59.75     |
| 1   | 57.7820           | 7780                     | 0488                         | -58.75    | 2   | 45.3146           |                          |                              |           |
| 2   | 54.7558           |                          |                              |           | 1   | 45.2333           | 1923                     | 0464                         | 48.44     |
| 2   | 48.8030           |                          |                              |           | 2   | 43.5841           |                          |                              |           |
| 1   | 48.7360           | 7034                     | 0606                         | 65.75     | 1   | 27.4760           | 3520                     | 0606                         | -52.60    |
| 1   | 47.4522           | 4162                     | 0542                         | 57.99     | 2   | 27.3713           |                          |                              |           |

Weighted mean ..... - 57.21  
 $V_a$  ..... +14.68  
 $V_d$  ..... 0.00  
 Curvature ..... - .28  
 Radial velocity ..... - 42.8

1907, July 2,  
G. M. T. 18<sup>h</sup> 12<sup>m</sup>

δ AQUILÆ 904.

Observed by W. E. HARPER.  
Measured by

| Wt. | Mean of Settings. | Computed Wave Lengths. | Corrected Wave Lengths. | Normal Wave Lengths. | Displacement. | Velocity. |
|-----|-------------------|------------------------|-------------------------|----------------------|---------------|-----------|
| 3   | 72.9426           | 4864.756               |                         | 943                  |               |           |
| 2   | 72.7683           | 4860.608               | 837                     | 527                  | 690           | -42.57    |
| 2   | 72.3857           | 4851.657               |                         | 686                  |               |           |
| 1   | 57.8055           | 4550.333               |                         | 642                  |               |           |
| 1½  | 57.7888           | 4550.031               | 332                     | 642                  | 310           | 20.43     |
| 1½  | 54.0165           | 4483.099               |                         | 413                  |               |           |
| 2   | 53.9383           | 4481.751               | 650                     | 400                  | 350           | 23.41     |
| 2   | 52.2391           | 4452.897               |                         | 180                  |               |           |
| 3   | 48.7760           | 4396.316               |                         | 382                  |               |           |
| 1   | 48.7398           | 4395.740               | 820                     | 286                  | 466           | 31.78     |
| 1½  | 47.4590           | 4375.754               | 774                     | 107                  | 333           | 22.88     |
| 2   | 45.2878           | 4342.183               |                         | 162                  |               |           |
| 2   | 45.2205           | 4341.168               | 108                     | 634                  | 526           | -36.29    |
| 1   | 42.1262           | 4295.425               |                         | 290                  |               |           |

Weighted mean ..... - 24.85  
 $V_a$  ..... + 5.63  
 $V_d$  ..... - .04  
 Curvature ..... - .28

Radial velocity ..... - 19.5

1907, July 8,  
G. M. T. 18<sup>h</sup> 02<sup>m</sup>

δ AQUILÆ 923.

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 54.7604           |                          |                              |           | 2   | 45.3152           |                          |                              |           |
| 1   | 53.9708           | .9458                    | .0240                        | -27.62    | 1   | 45.2452           | 2042                     | .0345                        | 36.01     |
| 2   | 53.1390           |                          |                              |           | 2   | 38.0093           |                          |                              |           |
| ½   | 52.4227           | .3947                    | .0201                        | 22.73     | 1   | 37.3176           | 2651                     | .0237                        | 22.72     |
| 2   | 52.2707           |                          |                              |           | 2   | 35.4883           |                          |                              |           |
| 2   | 48.8029           |                          |                              |           | 1   | 27.4678           | 3798                     | .0328                        | -28.47    |
| 1   | 45.9830           | .9440                    | .0400                        | 42.08     | 2   | 27.3349           |                          |                              |           |

Weighted mean ..... - 30.63  
 $V_a$  ..... + 2.96  
 $V_d$  ..... - .07  
 Curvature ..... - .28

Radial velocity ..... - 28.0

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5 AQUILÆ 930.

1907, July 9,  
G. M. T. 16<sup>h</sup> 33<sup>m</sup>

Observed by W. E. HARPER,  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 8333           |                          |                              |           | 1   | 48 7412           | 7360                     | 0289                         | 30.49     |
| 1   | 57 8169           | 8129                     | 0139                         | 16.73     | 1   | 47 4795           | 4670                     | 0034                         | 03.63     |
| 2   | 54 7487           |                          |                              |           | 2   | 45 2875           |                          |                              |           |
| 1   | 53 9750           | 9680                     | 0018                         | 02.07     | 1   | 45 2244           | 2104                     | 0283                         | 29.54     |
| 2   | 53 1198           |                          |                              |           | 2   | 37 9870           |                          |                              |           |
| 2   | 48 7812           |                          |                              |           | 1   | 37 2898           | 2620                     | 0268                         | -25.70    |

Weighted mean . . . . . -17.98  
 $V_a$  . . . . . + 2.54  
 $V_d$  . . . . . .08  
 Curvature . . . . . .28  
 Radial velocity . . . . . -15.6

5 AQUILÆ 938.

1907, July 10,  
G. M. T. 11<sup>h</sup> 30<sup>m</sup>

Observed by J. S. PLASKETT,  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8376           |                          |                              |           | 2             | 42 1585           |                          |                              |           |
| $\frac{1}{2}$ | 58 6448           | 6188                     | 0209                         | +25.41    | 1             | 41 8098           | 7538                     | 0778                         | -78.26    |
| 2             | 57 8525           |                          |                              |           | 2             | 38 0165           |                          |                              |           |
| 1             | 57 8362           | 8107                     | 0161                         | -19.38    | $\frac{1}{2}$ | 36 5035           | 4365                     | 0597                         | -56.77    |
| 2             | 54 7745           |                          |                              |           | 2             | 35 4998           |                          |                              |           |
| 2             | 48 8114           |                          |                              |           | 2             | 30 9556           |                          |                              |           |
| $\frac{1}{2}$ | 47 4796           | 4351                     | 0353                         | -38.47    | $\frac{1}{2}$ | 30 8842           | 8082                     | 0674                         | -60.52    |
| 2             | 45 3240           |                          |                              |           | 1             | 27 4150           | 3270                     | 0856                         | -74.30    |
| 1             | 45 2632           | 2128                     | 0255                         | -26.62    | 2             | 27 3430           |                          |                              |           |
| 1             | 44 2754           | 2239                     | 0148                         | -15.28    | 2             | 22 6507           |                          |                              |           |
| 2             | 43 5880           |                          |                              |           | $\frac{1}{2}$ | 22 6152           | 5153                     | 0791                         | -65.49    |

Weighted mean . . . . . -20.40  
 $V_a$  . . . . . + 2.18  
 $V_d$  . . . . . .00  
 Curvature . . . . . .28  
 Radial velocity . . . . . -18.5

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## ♂ AQUILAE 966.

1907, July 27,  
G. M. T. 19<sup>h</sup> 39Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57 7993           |                          |                              |           | 2             | 45 2612           |                          |                              |           |
| 1   | 57 7957           | 8227                     | 0041                         | -04 93    | $\frac{1}{3}$ | 45 2242           | 2252                     | 0155                         | 14 09     |
| 2   | 54 7201           |                          |                              |           | 2             | 43 5371           |                          |                              |           |
| 1   | 53 9306           | 9601                     | 0097                         | 11 16     | $\frac{1}{2}$ | 27 4259           | 3856                     | 0267                         | -23 17    |
| 2   | 53 0970           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean..... -11 57  
 $V_a$ ..... - 4 63  
 $V_d$ ..... - 02  
 Curvature..... - 28  
 Radial velocity..... -16 5

## ♂ AQUILAE 980.

1907, Aug. 3,  
G. M. T. 14<sup>h</sup> 49<sup>m</sup>Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8416           |                          |                              |           | $\frac{1}{3}$ | 46 0142           | 3765                     | 0100                         | -10 52    |
| $\frac{1}{2}$ | 59 0484           | 0185                     | 0222                         | -27 10    | 2             | 45 3113           |                          |                              |           |
| 2             | 57 8562           |                          |                              |           | 1             | 45 2599           | 2222                     | 0168                         | 17 55     |
| 1             | 57 8448           | 8178                     | 0090                         | 10 83     | $\frac{1}{3}$ | 44 2852           | 2468                     | 0130                         | 13 42     |
| 2             | 54 7701           |                          |                              |           | 2             | 43 5768           |                          |                              |           |
| 1             | 53 9962           | 9672                     | 0026                         | -02 99    | 1             | 41 8349           | 7965                     | 0387                         | 38 93     |
| 2             | 48 8045           |                          |                              |           | $\frac{1}{2}$ | 27 4712           | 3986                     | 0124                         | -10 76    |
| 1             | 47 5163           | 4893                     | 0099                         | -10 59    |               |                   |                          |                              |           |

Weighted mean..... -16 87  
 $V_a$ ..... - 8 53  
 $V_d$ ..... - 04  
 Curvature..... - 28  
 Radial velocity..... -25 7

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δ AQUILÆ 982.

1907. Aug. 5.  
G. M. T. 16<sup>h</sup> 36<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 57.8462           |                          |                              |           | 1   | 45.2591           | .2231                    | .0156                        | -16.28    |
| 1½  | 57.8389           | .8221                    | .0047                        | -05.65    | 2   | 44.2644           | .2274                    | .0318                        | 32.84     |
| 1   | 56.9690           | .9515                    | .0140                        | 16.68     | 2   | 43.5747           |                          |                              |           |
| 1   | 56.6945           |                          |                              |           | 2   | 42.1445           |                          |                              |           |
| 2   | 48.8009           |                          |                              |           | 1   | 41.8297           | .7872                    | .0441                        | 44.36     |
| 1   | 47.5019           | .4698                    | .0006                        | -00.64    | 2   | 30.9363           |                          |                              |           |
| 1½  | 46.0152           | .9812                    | .0060                        | +06.31    | 1   | 30.8976           | .8317                    | .0439                        | -39.42    |
| 2   | 45.3083           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... -19.60  
 $V_a$ ..... -9.42  
 $V_d$ ..... -09  
 Curvature..... -28  
 Radial velocity..... -29.4

δ AQUILÆ 1034.

1907. Sept. 6.  
G. M. T. 15<sup>h</sup> 44<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59.8664           |                          |                              |           | 2   | 43.5443           |                          |                              |           |
| 1½  | 57.8788           | .8313                    | .0045                        | +05.42    | 1   | 43.4850           |                          |                              |           |
| 1   | 57.8768           |                          |                              |           | 2   | 37.9634           |                          |                              |           |
| 2   | 54.7733           |                          |                              |           | 1   | 37.2692           | .2682                    | .0196                        | -18.79    |
| 1   | 54.0167           | .9887                    | .0189                        | +21.75    | 2   | 35.4242           |                          |                              |           |
| 2   | 48.7842           |                          |                              |           | 1½  | 35.1650           | .1650                    | .0160                        | +15.00    |
| 1   | 48.7878           | .7736                    | .0096                        | +10.42    | 2   | 30.8659           |                          |                              |           |
| 2   | 45.2868           |                          |                              |           | 1   | 30.8385           | .8425                    | .0331                        | -29.72    |
| 1   | 45.2454           | .2322                    | .0065                        | -06.78    | 1   | 27.3874           | .3944                    | .0182                        | -15.79    |

Weighted mean..... -3.84  
 $V_a$ ..... -21.09  
 $V_d$ ..... -16  
 Curvature..... -28  
 Radial velocity..... -25.4

δ AQUILÆ 1049 (a).

1907. Sept. 18.  
G. M. T. 8<sup>h</sup> 56<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by T. H. PARKER.

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 59 8694           |                          |                              |           | 2             | 41 3069           |                          |                              |           |
| 1              | 57 8779           | 8279                     | 0011                         | +01 32    | 2             | 37 9839           |                          |                              |           |
| 2              | 57 8775           |                          |                              |           | 1             | 37 2896           | 2646                     | 0242                         | - 23 20   |
| 1              | 57 6237           | 5757                     | 0189                         | + 22 68   | 1             | 39 8967           |                          |                              |           |
| $\frac{1}{2}$  | 55 1806           | 1351                     | 0099                         | +11 54    | 1             | 30 8663           | 8403                     | 0353                         | - 30 69   |
| 1              | 54 0309           | 9859                     | 0161                         | +18 53    | 1             | 27 4422           | 4182                     | 0056                         | + 04 86   |
| 2              | 53 1554           |                          |                              |           | 2             | 27 2681           |                          |                              |           |
| 2              | 45 3054           |                          |                              |           | 2             | 24 8642           |                          |                              |           |
| $1\frac{1}{2}$ | 45 2848           | 2508                     | 0121                         | +12 63    | 1             | 24 8329           | 8136                     | 0316                         | - 26 78   |
| 2              | 43 5724           |                          |                              |           | 2             | 22 5796           |                          |                              |           |
| 1              | 41 8318           | 8078                     | 0238                         | - 23 94   | $\frac{1}{2}$ | 22 5650           | 5412                     | 0146                         | - 12 08   |

Weighted mean ..... - 3 66  
 $V_a$  ..... - 24 00  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... - 28 0

δ AQUILÆ 1049 (b).

1907. Sept. 18.  
G. M. T. 8<sup>h</sup> 56<sup>m</sup>

Observed by J. N. TRIBBLE.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8589           |                          |                              |           | 1             | 42 5064           | 4794                     | 0314                         | - 31 80   |
| 1             | 57 8824           | 8409                     | 0141                         | +16 97    | 2             | 42 1333           |                          |                              |           |
| 2             | 57 8709           |                          |                              |           | $\frac{1}{2}$ | 41 8333           | 8073                     | 0243                         | - 24 44   |
| 1             | 57 6069           | 5659                     | 0091                         | +10 92    | 2             | 41 3082           |                          |                              |           |
| $\frac{1}{2}$ | 55 1507           | 1142                     | 0110                         | -12 82    | 2             | 37 9828           |                          |                              |           |
| $\frac{1}{4}$ | 54 0154           | 9804                     | 0106                         | +12 20    | $\frac{1}{2}$ | 37 3204           | 2984                     | 0096                         | + 09 20   |
| 2             | 45 3012           |                          |                              |           | 2             | 24 8630           |                          |                              |           |
| 1             | 45 2860           | 2575                     | 0188                         | +19 62    | $\frac{1}{2}$ | 24 8351           | 8173                     | 0279                         | - 23 63   |
| 2             | 43 5663           |                          |                              |           |               |                   |                          |                              |           |

Weighted mean ..... - 1 58  
 $V_a$  ..... - 24 00  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... - 25 9



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δ AQUILÆ 1543.

1908, May 18,  
G. M. T. 20<sup>h</sup> 06<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59·8118           |                          |                              |           | 2   | 45·2857           |                          |                              |           |
| 1   | 59·6115           | 6090                     | 0655                         | -80·56    | 1   | 45·1924           | 1819                     | 0568                         | 59·29     |
| 1½  | 57·7867           | 7867                     | 0401                         | 48·28     | 1   | 44·2082           | 1967                     | 0625                         | 64·56     |
| 1½  | 56·9378           | 9388                     | 0267                         | 31·82     | 2   | 43·5501           |                          |                              |           |
| 2   | 56·6665           |                          |                              |           | 1   | 39·9986           | 9811                     | 0352                         | 34·35     |
| 1½  | 55·0793           | 0793                     | 0459                         | 53·51     | 1½  | 37·2334           | 2134                     | 0754                         | 72·30     |
| 1   | 53·9367           | 9352                     | 0346                         | 39·82     | 2   | 37·9775           |                          |                              |           |
| 2   | 53·1154           |                          |                              |           | 2   | 30·8437           | 8107                     | 0649                         | 58·27     |
| 1½  | 52·3898           | 3868                     | 0280                         | 31·66     | 1½  | 27·3944           | 3544                     | 0582                         | -50·50    |
| 1   | 51·6895           | 6860                     | 0715                         | 80·22     | 2   | 27·2870           |                          |                              |           |
| 2   | 48·7751           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... - 43·49  
 $V_a$ ..... - 21·88  
 $V_d$ ..... - 01  
 Curvature..... - 28  
 Radial velocity..... - 21·9

δ AQUILÆ 1550.

1908, May 22,  
G. M. T. 20<sup>h</sup> 34<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59·8566           |                          |                              |           | 2   | 43·5800           |                          |                              |           |
| 1   | 53·9680           | 9260                     | 0438                         | -50·41    | 1   | 43·5040           | 4590                     | 0742                         | 75·90     |
| 2   | 53·1527           |                          |                              |           | 1½  | 42·4743           | 4268                     | 0840                         | 85·09     |
| 1½  | 52·4092           | 3682                     | 0466                         | 52·70     | 2½  | 37·3817           |                          |                              |           |
| 1   | 51·7194           | 6799                     | 0796                         | 89·31     | 1   | 37·3052           | 2552                     | 0336                         | 32·22     |
| 2   | 50·0548           |                          |                              |           | 1½  | 30·8480           | 7940                     | 0816                         | 73·26     |
| 2   | 45·3223           |                          |                              |           | 1   | 27·4542           | 3942                     | 0184                         | -15·97    |
| 1   | 45·2179           | 1724                     | 0663                         | 70·54     | 2   | 27·3097           |                          |                              |           |

Weighted mean..... - 60·57  
 $V_a$ ..... +20·77  
 $V_d$ ..... 00  
 Curvature..... - 28  
 Radial velocity..... - 40·1

♁ AQUILÆ 1575.

1908. June 3.  
G. M. T. 20<sup>h</sup> 01<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8247           |                          |                              |           | 2              | 50 0325           |                          |                              |           |
| 1             | 58 9976           | 9581                     | 0581                         | -71 11    | 1              | 48 7496           | 7236                     | 0404                         | 43 95     |
| 2             | 57 7944           | 7574                     | 0473                         | 57 04     | 2              | 45 3116           |                          |                              |           |
| 2             | 57 8347           |                          |                              |           | 2              | 45 2466           | 2206                     | 0281                         | 29 42     |
| 1             | 56 9377           | 9027                     | 0426                         | 50 86     | 1              | 44 2465           | 2215                     | 0508                         | 52 62     |
| 2             | 56 6840           |                          |                              |           | 2              | 43 9500           | 9060                     | 0345                         | 35 60     |
| $\frac{1}{2}$ | 55 1020           | 0700                     | 0391                         | 45 70     | 2              | 41 3243           |                          |                              |           |
| 1             | 53 9550           | 9250                     | 0316                         | 35 22     | $1\frac{1}{2}$ | 37 3066           | 2946                     | 0304                         | -29 24    |

Weighted mean. . . . . - 45 35  
 $V_a$  . . . . . +16 94  
 $V_d$  . . . . . - 04  
 Curvature . . . . . - 28

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Radial velocity. . . . . - 28 7

♁ AQUILÆ 1575.

1908. June 3.  
G. M. T. 20<sup>h</sup> 01<sup>m</sup>

Observed by W. E. HARPER.  
Measured by j

| Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2              | 57 7480           |                          |                              |           | 2              | 45 2208           |                          |                              |           |
| 2              | 57 7020           | 7562                     | 0475                         | -57 28    | 1              | 45 1452           | 2080                     | 0307                         | 32 14     |
| 1              | 56 8536           | 9100                     | 0353                         | 42 15     | 1              | 44 1533           | 2163                     | 0560                         | 58 02     |
| 2              | 56 5944           |                          |                              |           | $\frac{1}{2}$  | 42 3660           | 4300                     | 0406                         | 41 29     |
| 1              | 55 0194           | 0796                     | 0295                         | 34 48     | 2              | 42 0584           |                          |                              |           |
| 2              | 54 6613           |                          |                              |           | 1              | 41 2210           | 2860                     | 0337                         | 33 83     |
| $1\frac{1}{2}$ | 53 8672           | 9287                     | 0279                         | 32 20     | 2              | 39 6969           |                          |                              |           |
| 2              | 53 0411           |                          |                              |           | 1              | 38 6841           | 7516                     | 0318                         | 31 07     |
| 1              | 52 2948           | 3573                     | 0479                         | 54 27     | 1              | 37 2157           | 2842                     | 0408                         | 39 25     |
| 2              | 52 1800           |                          |                              |           | 2              | 30 8595           |                          |                              |           |
| 2              | 48 7090           |                          |                              |           | $1\frac{1}{2}$ | 30 7894           | 8774                     | 0585                         | 32 77     |
| $\frac{1}{2}$  | 48 6414           | 7039                     | 0601                         | 65 39     | 2              | 22 5580           |                          |                              |           |
| 1              | 45 8895           | 9522                     | 0430                         | 45 36     | 1              | 22 4961           | 5909                     | 0619                         | -51 56    |

Weighted mean. . . . . - 44 84  
 $V_a$  . . . . . +16 94  
 $V_d$  . . . . . - 04  
 Curvature . . . . . - 28

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Radial velocity. . . . . - 28 2

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♁ AQUILÆ 1584.

1908, June 5.  
G. M. T. 20<sup>h</sup> 35<sup>m</sup>

Observed by T. H. PARKER.  
Measured by J.

| Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 1               | 59 8185           |                          |                              |           | 1               | 45 1990           | 1958                     | 0429                         | 44 78     |
| 1               | 59 6231           | 6140                     | 0605                         | 74 41     | 2               | 37 9604           |                          |                              |           |
| 1               | 57 7645           | 7645                     | 0623                         | 75 00     | $\frac{1}{2}$   | 37 2349           | 2404                     | 0481                         | 46 41     |
| 2               | 56 6595           |                          |                              |           | 2               | 36 4205           | 4255                     | 0707                         | 67 23     |
| 1               | 53 9346           | 9376                     | 0322                         | 37 06     | 1               | 35 1146           | 1186                     | 0304                         | 28 51     |
| 2               | 53 1106           |                          |                              |           | 2               | 35 4265           |                          |                              |           |
| 1               | 52 3912           | 3908                     | 0240                         | 27 14     | 1 $\frac{1}{2}$ | 30 8236           | 8176                     | 0580                         | 52 08     |
| 1               | 51 7052           | 7022                     | 0553                         | 62 04     | 1               | 27 3774           | 3664                     | 0462                         | 40 10     |
| 1 $\frac{1}{2}$ | 50 9223           | 9183                     | 0348                         | 38 69     | 1               | 27 2576           |                          |                              |           |
| 1               | 50 0435           |                          |                              |           | 1 $\frac{1}{2}$ | 18 8335           |                          | 0441                         | - 35 23   |
| 1               | 48 7062           | 7012                     | 0618                         | 67 10     | 1               | 18 8776           |                          |                              |           |
| 2               | 45 2570           |                          |                              |           |                 |                   |                          |                              |           |

Weighted mean..... - 51 40  
 $V_a$ ..... + 16 22  
 $V_d$ ..... - 09  
 Curvature..... - 28  
 Radial velocity..... 35 5

♁ AQUILÆ 1633.

1908, June 24.  
G. M. T. 18<sup>h</sup> 31<sup>m</sup>

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.             | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8112           |                          |                              |           | 1               | 45 2090           | 2005                     | 0382                         | 39 88     |
| 1             | 57 7871           | 7941                     | 0327                         | - 39 37   | 2               | 44 2642           |                          |                              |           |
| 2             | 57 8218           |                          |                              |           | 2               | 41 2960           |                          |                              |           |
| $\frac{1}{2}$ | 55 4842           | 4887                     | 0355                         | 41 33     | 1               | 40 4965           | 4875                     | 0385                         | 38 09     |
| 2             | 54 7384           |                          |                              |           | 2               | 35 4349           |                          |                              |           |
| 1             | 53 9350           | 9365                     | 0333                         | 38 32     | 1               | 35 3907           | 3857                     | 0419                         | 39 42     |
| 2             | 53 1133           |                          |                              |           | 1 $\frac{1}{2}$ | 27 3962           | 3792                     | 0334                         | - 28 99   |
| 2             | 45 2822           |                          |                              |           | 2               | 27 2636           |                          |                              |           |

Weighted mean..... - 37 91  
 $V_a$ ..... + 8 74  
 $V_d$ ..... 00  
 Curvature..... - 28  
 Radial velocity..... - 29 5

♁ AQUILE 1642.

1908. June 26.  
G. M. T. 18<sup>h</sup> 52<sup>m</sup>

Observed by T. H. PARKER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8137           |                          |                              |           | 2              | 43 5225           |                          |                              |           |
| 1             | 59 4942           |                          |                              |           | $\frac{1}{2}$  | 42 6036           | 6166                     | 0230                         | 23 34     |
| $\frac{1}{2}$ | 58 9788           | 9748                     | 0659                         | 80 46     | 2              | 42 1050           |                          |                              |           |
| 1             | 58 5962           | 5922                     | 0057                         | 6 93      | $\frac{1}{2}$  | 41 7834           | 7807                     | 0352                         | 35 41     |
| 2             | 57 8290           |                          |                              |           | 1              | 40 4726           | 4735                     | 0413                         | 40 96     |
| 1             | 57 7667           | 7637                     | 0631                         | 75 97     | 2              | 39 7305           |                          |                              |           |
| 5             | 56 6748           |                          |                              |           | 2              | 37 9465           |                          |                              |           |
| 1             | 53 9205           | 9215                     | 0483                         | 55 59     | $1\frac{1}{2}$ | 37 6386           | 7096                     | 0451                         | 43 47     |
| 5             | 53 1059           |                          |                              |           | $\frac{1}{2}$  | 37 2113           | 2218                     | 0670                         | 64 25     |
| 1             | 51 6633           | 6683                     | 0892                         | 100 08    | 2              | 35 4224           |                          |                              |           |
| 2             | 48 7623           |                          |                              |           | 2              | 30 8643           |                          |                              |           |
| 1             | 48 7182           | 7272                     | 0368                         | 39 94     | 1              | 30 7867           | 7907                     | 0849                         | 80 64     |
| 3             | 45 2623           |                          |                              |           | 1              | 27 3707           | 3691                     | 0434                         | -37 67    |
| 1             | 45 1842           | 1967                     | 0420                         | 43 84     | 2              | 27 2482           |                          |                              |           |
| 1             | 44 1888           | 2018                     | 0574                         | 59 29     |                |                   |                          |                              |           |

Weighted mean ..... - 47 30  
 $V_a$  ..... + 7 87  
 $V_d$  ..... - 09  
 Curvature ..... - 28  
 Radial velocity ..... - 39 8

♁ AQUILE 1650.

1908. June 27.  
G. M. T. 18<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.            | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|----------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8350           |                          |                              |           | 1              | 40 5070           | 4860                     | 0400                         | 39 68     |
| 2             | 57 8130           | 7880                     | 0388                         | -46 71    | 2              | 39 7571           |                          |                              |           |
| 1             | 57 8512           |                          |                              |           | $1\frac{1}{2}$ | 39 6936           | 6736                     | 0532                         | 52 34     |
| 1             | 56 9804           | 9559                     | 0696                         | 11 40     | 1              | 38 7283           | 7123                     | 0400                         | 48 70     |
| 2             | 56 6977           |                          |                              |           | 3              | 37 9723           |                          |                              |           |
| 1             | 55 1051           | 0841                     | 0411                         | 47 92     | 1              | 37 2502           | 2362                     | 0526                         | 50 44     |
| 2             | 54 7645           |                          |                              |           | 1              | 36 4397           | 4257                     | 0715                         | 67 28     |
| $\frac{1}{2}$ | 53 9517           | 9337                     | 0361                         | 41 55     | 2              | 35 4463           |                          |                              |           |
| 3             | 53 1253           |                          |                              |           | 2              | 30 9004           |                          |                              |           |
| 1             | 51 6990           | 6860                     | 0715                         | 80 22     | $1\frac{1}{2}$ | 30 8548           | 8248                     | 0508                         | 45 70     |
| 2             | 49 3733           | 3583                     | 0691                         | 10 21     | 1              | 27 3920           | 3600                     | 0526                         | 45 65     |
| 2             | 48 7901           |                          |                              |           | 2              | 27 2785           |                          |                              |           |
| 1             | 48 7440           | 7270                     | 0370                         | 40 14     | $\frac{1}{2}$  | 24 8214           | 7912                     | 0554                         | 46 86     |
| 2             | 45 2955           |                          |                              |           | 1              | 24 1079           | 0789                     | 0543                         | 45 12     |
| 1             | 45 2045           | 1835                     | 0552                         | 57 62     | 2              | 24 8754           |                          |                              |           |
| 1             | 44 2292           | 2077                     | 0515                         | 53 19     | 2              | 22 5904           |                          |                              |           |
| 2             | 43 5514           |                          |                              |           | 1              | 22 5118           | 4782                     | 0786                         | 65 08     |
| 2             | 42 1240           |                          |                              |           | 1              | 18 8332           | 7823                     | 0669                         | -48 65    |
| 1             | 41 2768           | 2558                     | 0414                         | 41 40     | 2              | 18 8913           |                          |                              |           |
| $\frac{1}{2}$ | 40 7692           | 6882                     | 0610                         | 60 79     |                |                   |                          |                              |           |

Weighted mean ..... - 48 20  
 $V_a$  ..... + 7 54  
 $V_d$  ..... - 04  
 Curvature ..... - 28  
 Radial velocity ..... - 41 0

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♁ AQUILÆ 1660.

1908, June 27.  
G. M. T. 18<sup>h</sup> 09<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59 8256           |                          |                              |           | 2   | 45 2745           |                          |                              |           |
| 1   | 57 7919           | 7829                     | 0070                         | - 8.42    | 1½  | 45 2107           | 2907                     | 0290                         | 39.27     |
| 2   | 57 8327           |                          |                              |           | 1   | 44 2220           | 2215                     | 0377                         | 38.94     |
| ½   | 56 9519           | 9499                     | 0206                         | 24.55     | 1   | 41 7726           | 7741                     | 0575                         | 57.84     |
| 2   | 56 6750           |                          |                              |           | 2   | 41 2848           |                          |                              |           |
| 2   | 54 7459           |                          |                              |           | 2   | 41 2964           |                          |                              |           |
| 1   | 53 9418           | 9398                     | 0300                         | 34.53     | 1   | 39 0028           | 9838                     | 0325                         | 31.75     |
| 1   | 53 7200           | 7215                     | 0360                         | 40.39     | 2   | 37 9669           |                          |                              |           |
| 1   | 48 7544           | 7579                     | 0079                         | 8.57      | 1   | 37 2796           | 2726                     | 0162                         | - 15.53   |
| 2   | 48 7663           |                          |                              |           | 2   | 35 4331           |                          |                              |           |

Weighted mean..... - 29.35  
 $V_a$ ..... + 7.66  
 $V_d$ ..... 00  
 Curvature..... - 28  
 Radial velocity..... - 21.9

♁ AQUILÆ 1678

1908, July 8.  
G. M. T. 18<sup>h</sup> 10<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59 8005           |                          |                              |           | 2   | 43 5657           |                          |                              |           |
| ½   | 58 9967           | 0037                     | 0370                         | - 45.21   | 2   | 41 8142           | 7845                     | 0471                         | 47.38     |
| 2   | 58 5482           | 5532                     | 0427                         | 51.88     | 2   | 41 3185           |                          |                              |           |
| 1   | 57 7767           | 7837                     | 0431                         | 51.89     | 2   | 37 9962           |                          |                              |           |
| 2   | 57 8125           |                          |                              |           | 1½  | 37 7667           | 7297                     | 0250                         | 24.10     |
| 1   | 56 9345           | 9415                     | 0240                         | 28.60     | 1½  | 37 2799           | 2429                     | 0459                         | 44.01     |
| 2   | 56 6620           |                          |                              |           | 2   | 35 4685           |                          |                              |           |
| 1   | 53 9232           | 9322                     | 0376                         | 43.27     | 2   | 30 9250           |                          |                              |           |
| 2   | 53 1017           |                          |                              |           | 1   | 30 8610           | 8064                     | 0692                         | 62.14     |
| 2   | 53 1317           |                          |                              |           | 1   | 27 4311           | 3611                     | 0515                         | 44.70     |
| 1   | 51 7239           | 7039                     | 0536                         | 60.13     | 2   | 27 3166           |                          |                              |           |
| 1   | 48 7590           | 7370                     | 0270                         | 29.29     | 2   | 24 9161           |                          |                              |           |
| 2   | 48 7919           |                          |                              |           | 1½  | 24 8730           | 8080                     | 0372                         | 31.50     |
| 1   | 47 4680           | 4434                     | 0270                         | 28.89     | 2   | 22 6292           |                          |                              |           |
| 2   | 45 3027           |                          |                              |           | 1½  | 22 5788           | 5063                     | 0505                         | 41.81     |
| 1½  | 45 2398           | 2138                     | 0249                         | 25.99     | 2   | 18 9394           |                          |                              |           |
| 1   | 44 2427           | 2157                     | 0435                         | 44.93     | ½   | 18 9059           | 8099                     | 0335                         | - 26.76   |

Weighted mean..... - 38.83  
 $V_a$ ..... + 2.80  
 $V_d$ ..... - .09  
 Curvature..... - 28  
 Radial velocity..... - 36.4

♁ AQUILÆ 1690.

1908. July 10.  
G. M. T. 18<sup>h</sup> 37<sup>m</sup>

Observed by } T. H. PARKER.  
Measured by }

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59 8492           |                          |                              |           | ½   | 45 2276           | 2066                     | 0321                         | 33 51     |
| 1   | 57 8233           | 7873                     | 0395                         | -47 55    | 2   | 44 2779           |                          |                              |           |
| 2   | 57 8653           |                          |                              |           | ½   | 44 2522           | 2336                     | 0256                         | 26 44     |
| ½   | 55 1478           | 1183                     | 0069                         | 8 04      | 2   | 43 5578           |                          |                              |           |
| 2   | 58 9789           | 9519                     | 0179                         | 20 60     | 1   | 43 5248           | 5053                     | 0279                         | 28 59     |
| 2   | 54 7702           |                          |                              |           | 2   | 39 7623           |                          |                              |           |
| 1   | 53 6528           | 6260                     | 0415                         | 47 60     | 1   | 38 7677           | 7407                     | 0116                         | 11 29     |
| 2   | 53 1388           |                          |                              |           | 1   | 37 7768           | 7483                     | 0161                         | -15 52    |
| 1   | 47 4598           | 4877                     | 0327                         | 34 98     | 2   | 37 9904           |                          |                              |           |
| 2   | 45 2945           |                          |                              |           |     |                   |                          |                              |           |

Weighted mean..... - 27 41  
 $V_a$ ..... +1 71  
 $V_d$ ..... - 12  
 Curvature..... - 28  
 Radial velocity..... - 26 1

♁ AQUILÆ 1695.

1908. July 11.  
G. M. T. 18<sup>h</sup> 27<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|-----|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2   | 59 8527           |                          |                              |           | 2   | 45 3050           |                          |                              |           |
| 1   | 59 6739           | 6354                     | 0391                         | -48 13    | ½   | 45 2435           | 2215                     | 0172                         | 17 95     |
| ½   | 59 0715           | 0335                     | 0396                         | 48 39     | 2   | 44 2905           |                          |                              |           |
| 1   | 57 8545           | 8185                     | 0083                         | 11 19     | ½   | 44 2539           | 2224                     | 0368                         | 37 97     |
| 2   | 57 8587           |                          |                              |           | 2   | 42 1319           |                          |                              |           |
| ½   | 56 9778           | 9428                     | 0233                         | 27 77     | 1½  | 41 8032           | 7749                     | 0567                         | 57 04     |
| 2   | 56 7102           |                          |                              |           | 2   | 39 7632           |                          |                              |           |
| 1   | 55 1281           | 0941                     | 0311                         | 36 26     | 1   | 38 7665           | 7405                     | 0118                         | 11 49     |
| 2   | 54 7768           |                          |                              |           | 2   | 30 9112           |                          |                              |           |
| 1   | 53 9813           | 9473                     | 0225                         | 25 89     | ½   | 30 8476           | 8146                     | 0610                         | 54 74     |
| 2   | 53 1442           |                          |                              |           | 1   | 27 4370           | 3990                     | 0136                         | 11 80     |
| 1   | 52 4120           | 3790                     | 0358                         | 40 48     | 2   | 27 2825           |                          |                              |           |
| 1   | 51 7425           | 7085                     | 0490                         | 54 97     | 2   | 18 8835           |                          |                              |           |
| 2   | 48 8042           |                          |                              |           | 1   | 18 8525           | 8124                     | 0310                         | -24 5     |
| 1½  | 47 4810           | 4485                     | 0219                         | 23 43     |     |                   |                          |                              |           |

Weighted mean..... - 35 50  
 $V_a$ ..... +1 26  
 $V_d$ ..... - 12  
 Curvature..... - 28  
 Radial velocity..... - 34 6

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δ AQUILÆ 1703.

1908. July 13.  
G. M. P. 18<sup>h</sup> 52<sup>m</sup>

Observed by T. H. PARKER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8060           |                          |                              |           | 2   | 37 9609           |                          |                              |           |
| $\frac{1}{2}$ | 57 7842           | 7832                     | 0436                         | 52 49     | 1   | 37 2499           | 2469                     | 0419                         | 40 18     |
| $\frac{1}{2}$ | 56 9494           | 9484                     | 0171                         | 26 38     | 2   | 30 8904           |                          |                              |           |
| 2             | 54 7423           |                          |                              |           | 1   | 30 8531           | 8331                     | 0425                         | 38 15     |
| 2             | 45 2766           |                          |                              |           | 1   | 27 4061           | 3769                     | 0357                         | 30 98     |
| $\frac{1}{2}$ | 45 1916           | 1896                     | 0491                         | 51 26     | 2   | 27 2758           |                          |                              |           |
| 2             | 43 5362           |                          |                              |           | 2   | 22 5816           |                          |                              |           |
| 1             | 43 4567           | 4587                     | 0745                         | 76 36     | 1   | 22 5331           | 5083                     | 0485                         | 39 77     |

Weighted mean . . . . . 43 25  
 $V_a$  . . . . . 0 36  
 $V_d$  . . . . . 16  
 Curvature . . . . . 28  
 Radial velocity . . . . . 13 3

δ AQUILÆ 1753.

1908. July 31.  
G. M. T. 16<sup>h</sup> 41<sup>m</sup>

Observed by T. H. PARKER.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2             | 30 8945           |                          |                              |           | 2   | 22 5725           |                          |                              |           |
| 1             | 30 8828           | 8588                     | 0168                         | -15 08    | 1   | 22 5388           | 5231                     | 0387                         | 32 04     |
| $\frac{1}{2}$ | 27 4102           | 3822                     | 0304                         | 26 38     | 2   | 18 8774           |                          |                              |           |
| 2             | 27 2757           |                          |                              |           | 1   | 18 8637           |                          | 0137                         | -10 94    |

Weighted mean . . . . . -22 81  
 $V_a$  . . . . . -7 60  
 $V_d$  . . . . . 09  
 Curvature . . . . . 28  
 Radial velocity . . . . . -30 7

9-10 EDWARD VII., A. 1910

1908, July 31,  
G. M. T. 17<sup>h</sup> 17<sup>m</sup>

♁ AQUILÆ 1754.

Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt. | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|-----|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 54 7652           |                          |                              |           | 2   | 43 5520           |                          |                              |           |
| 2                    | 53 9794           | 9574                     | 0124                         | 14 27     | 2   | 37 9742           |                          |                              |           |
| 2                    | 53 1334           |                          |                              |           | 1   | 37 2646           | 2496                     | 0402                         | 38 55     |
| 2                    | 48 7862           |                          |                              |           | 2   | 30 8961           |                          |                              |           |
| 1                    | 47 4588           | 4418                     | 0286                         | 30 60     | 1   | 30 8566           | 8346                     | 0420                         | 37 71     |
| 1                    | 45 9683           | 9533                     | 0307                         | 32 29     | 1   | 27 4200           | 3950                     | 0176                         | 15 27     |
| 2                    | 45 2930           |                          |                              |           | 2   | 27 2700           |                          |                              |           |
| 1                    | 15 2278           | 2128                     | 0259                         | 27 03     |     |                   |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |     |                   |                          |                              | -26 25    |
| $V_a$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 7 61    |
| $V_d$ .....          |                   |                          |                              |           |     |                   |                          |                              | - 12      |
| Curvature.....       |                   |                          |                              |           |     |                   |                          |                              | - 28      |
| Radial velocity..... |                   |                          |                              |           |     |                   |                          |                              | -34 2     |

♁ AQUILÆ 1754.\*

1908, July 31,  
G. M. T. 17<sup>h</sup> 17<sup>m</sup>Observed by W. E. HARPER.  
Measured by T. H. PARKER.

| Wt.                  | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|----------------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2                    | 54 7189           |                          |                              |           | 1             | 45 1899           | 2129                     | 0258                         | 26 93     |
| 1                    | 53 9370           | 9375                     | 0123                         | -14 15    | $\frac{1}{2}$ | 44 2025           | 2255                     | 0337                         | 34 81     |
| 2                    | 53 0936           |                          |                              |           | 2             | 43 5112           |                          |                              |           |
| $\frac{1}{2}$        | 52 3557           | 3772                     | 0376                         | 42 52     | 2             | 37 9405           |                          |                              |           |
| $\frac{1}{2}$        | 48 7477           |                          |                              |           | 1             | 37 2294           | 2504                     | 0384                         | 36 82     |
| $\frac{1}{3}$        | 48 6982           | 7212                     | 0428                         | 46 48     | $\frac{1}{2}$ | 27 3766           | 3883                     | 0240                         | -20 84    |
| $\frac{1}{3}$        | 47 4122           | 4352                     | 0352                         | 37 66     | 2             | 27 2349           |                          |                              |           |
| 2                    | 45 2530           |                          |                              |           |               |                   |                          |                              |           |
| Weighted mean.....   |                   |                          |                              |           |               |                   |                          |                              | -36 05    |
| $V_a$ .....          |                   |                          |                              |           |               |                   |                          |                              | - 7 61    |
| $V_d$ .....          |                   |                          |                              |           |               |                   |                          |                              | - 12      |
| Curvature.....       |                   |                          |                              |           |               |                   |                          |                              | - 28      |
| Radial velocity..... |                   |                          |                              |           |               |                   |                          |                              | -44 0     |

\*Check measurement.



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♄ AQUILÆ 1768.

1908, Aug. 5,  
G. M. T. 18<sup>h</sup> 05<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 59 8186           |                          |                              |           | 1             | 45 9871           | 9876                     | 0036                         | 3 78      |
| 1             | 57 8102           | 8077                     | 0191                         | 22 99     | 2             | 45 2749           |                          |                              |           |
| 2             | 57 8271           |                          |                              |           | 1             | 45 2148           | 2168                     | 0219                         | 22 86     |
| 2             | 54 7437           |                          |                              |           | 1             | 44 2346           | 2376                     | 0216                         | 22 51     |
| $\frac{1}{2}$ | 53 9784           | 9784                     | 0086                         | 9 89      | 2             | 43 5328           |                          |                              |           |
| 2             | 53 1097           |                          |                              |           | 1             | 41 7874           | 7924                     | 0302                         | 39 43     |
| $\frac{1}{2}$ | 52 4313           | 4303                     | 0155                         | 17 53     | 2             | 41 2791           |                          |                              |           |
| 2             | 52 2541           |                          |                              |           | 2             | 39 8758           |                          |                              |           |
| 2             | 48 7696           |                          |                              |           | $\frac{1}{2}$ | 27 3845           | 3779                     | 0361                         | 31 33     |
| 1             | 48 7376           | 7361                     | 0279                         | 30 29     | 2             | 27 2532           |                          |                              |           |

Weighted mean . . . . . 19 51  
 $V_a$  . . . . . 9 77  
 $V_d$  . . . . . 19  
 Curvature . . . . . 28  
 Radial velocity . . . . . 29 7

♄ AQUILÆ 1783.

1908, Aug. 15,  
G. M. T. 17<sup>h</sup> 38<sup>m</sup>

Observed by J. S. PLASKETT.  
Measured by T. H. PARKER.

| Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. | Wt.           | Mean of Settings. | Corrected Star Settings. | Displacement in Revolutions. | Velocity. |
|---------------|-------------------|--------------------------|------------------------------|-----------|---------------|-------------------|--------------------------|------------------------------|-----------|
| 2             | 57 8126           |                          |                              |           | 2             | 45 2802           |                          |                              |           |
| 1             | 57 8193           | 8023                     | 0245                         | 29 49     | 1             | 45 2457           | 2404                     | 0020                         | + 2 08    |
| 2             | 54 7335           |                          |                              |           | $\frac{1}{2}$ | 44 2265           | 2205                     | 0387                         | 39 97     |
| 1             | 53 9473           | 9573                     | 0125                         | 14 38     | 2             | 43 5434           |                          |                              |           |
| 2             | 53 0995           |                          |                              |           | 1             | 41 3061           | 2951                     | 0021                         | 2 10      |
| $\frac{1}{2}$ | 52 4002           | 4072                     | 0076                         | 8 58      | $\frac{1}{2}$ | 10 5358           | 5258                     | 0021                         | 2 08      |
| 2             | 52 2469           |                          |                              |           | 2             | 37 9743           |                          |                              |           |
| $\frac{1}{2}$ | 51 7060           | 7120                     | 0455                         | 51 05     | 1             | 37 2659           | 2499                     | 0389                         | 37 30     |
| 1             | 49 3467           | 3487                     | 0213                         | 23 25     | 2             | 30 9025           |                          |                              |           |
| 1             | 48 7663           |                          |                              |           | 1             | 29 8983           | 8643                     | 0105                         | 9 51      |
| $\frac{1}{2}$ | 48 7345           | 7360                     | 0280                         | 30 38     | $\frac{1}{2}$ | 27 4506           | 4116                     | 0010                         | 0 86      |
| 1             | 47 4838           | 4828                     | 0124                         | +13 26    | 2             | 27 2858           |                          |                              |           |
| $\frac{1}{2}$ | 45 9813           | 9773                     | 0073                         | - 7 67    |               |                   |                          |                              |           |

Weighted mean . . . . . -14 85  
 $V_a$  . . . . . -13 84  
 $V_d$  . . . . . - 22  
 Curvature . . . . . - 28  
 Radial velocity . . . . . -29 2

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1908. Aug. 27.  
G. M. T. 15<sup>h</sup> 03<sup>m</sup>

δ AQUILÆ 1837.

Observed by J. B. CANNON.  
Measured by T. H. PARKER.

| Wt.           | Mean<br>of<br>Settings. | Corrected<br>Star<br>Settings. | Displace-<br>ment in<br>Revolutions. | Velocity. | Wt.           | Mean<br>of<br>Settings. | Corrected<br>Star<br>Settings. | Displace-<br>ment in<br>Revolutions. | Velocity. |
|---------------|-------------------------|--------------------------------|--------------------------------------|-----------|---------------|-------------------------|--------------------------------|--------------------------------------|-----------|
| 2             | 73 0183                 |                                |                                      |           | 2             | 45 2880                 |                                |                                      |           |
| $\frac{1}{2}$ | 72 8513                 | 8430                           | 0218                                 | - 31 63   | 1             | 45 2372                 | 2232                           | 0155                                 | - 16 18   |
| 2             | 72 4532                 |                                |                                      |           | 1             | 44 2396                 | 2264                           | 0328                                 | - 33 91   |
| 2             | 59 8129                 |                                |                                      |           | 2             | 43 5517                 |                                |                                      |           |
| 1             | 57 8288                 | 8283                           | 0015                                 | + 1 80    | 1             | 41 8079                 | 7949                           | 0367                                 | - 36 92   |
| 2             | 54 7500                 |                                |                                      |           | 1             | 37 9771                 |                                |                                      |           |
| 1             | 53 9747                 | 9667                           | 0031                                 | - 3 56    | 1             | 37 3070                 | 2925                           | 0037                                 | + 3 54    |
| 2             | 53 1197                 |                                |                                      |           | 2             | 36 9079                 |                                |                                      |           |
| $\frac{1}{2}$ | 51 7273                 | 7173                           | 0402                                 | - 45 10   | $\frac{1}{2}$ | 30 8756                 | 8386                           | 0370                                 | - 33 22   |
| 2             | 48 7819                 |                                |                                      |           | 1             | 30 4141                 | 3751                           | 0375                                 | - 32 55   |
| 1             | 47 4976                 | 4846                           | 0142                                 | + 15 19   | 2             | 30 2857                 |                                |                                      |           |
| $\frac{1}{2}$ | 46 0043                 | 9915                           | 0041                                 | + 4 31    |               |                         |                                |                                      |           |

Weighted mean . . . . . - 20 35  
 $V_d$  . . . . . - 18 18  
 $V_d$  . . . . . 09  
Curvature . . . . . - 28  
Radial velocity . . . . . - 39 5

**APPENDIX 3.**

REPORT OF THE CHIEF ASTRONOMER, 1909.

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**MERIDIAN WORK AND TIME SERVICE**

BY

**R. M. STEWART, M.A.**



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## APPENDIX 3.

## REPORT OF R. M. STEWART, M.A., ON MERIDIAN WORK AND TIME SERVICE.

OTTAWA, March 31, 1909.

W. F. KING, Esq., LL.D., C.M.G.,  
 Chief Astronomer,  
 Department of the Interior,  
 Ottawa.

SIR.—I have the honour to report as follows on the work carried out under my charge during the past fiscal year.

A great part of the year has been taken up with work in connection with the fitting up of the Transit Annex, including the reconstruction of the piers, and with tests and alterations of the Meridian Circle. As will be seen below, the latter has proved to be defective in many respects, necessitating a great deal of work in the alterations required before it can be made to perform creditably; among the most important and laborious of the operations were the renewing of the pivots and the truing up of the planes of the circles; further alterations still remain to be made. The usual amount of observation and computation has been done for determination of clock error, more particularly in connection with the operations carried on in the field for determination of longitudes. The question of personal equation was considered, and a special series of observations made in an attempt to discover the laws which it followed. The differences of personal equation found were in some cases comparatively large; the personal equations of at least two of the observers appeared to be due to a tendency always to set the movable wire asymmetrically with respect to a star image when estimating a bisection; in the case of one observer this error of bisection amounted to over a second of arc. The time service has been maintained as in the past, and has been extended to include the Mint and the Archives Building. An analysis was made of the rate of the Standard Sidereal Clock; an account of this is given in Appendix A below.

## THE TRANSIT ANNEX.

The Transit Annex, which is located at the western end of the main building, consists of two rooms, the Transit Room and the Meridian Circle Room. The former is connected to the main building by two doors, one opening into the Chronograph Room, and through it into the Time Room, the other communicating with the main hall-way. In it are situated two piers for the portable astronomical transits belonging to the Observatory, the western one of which is also provided with two collimator piers. The inside dimensions of this room are 21 ft. 4 in. in the meridian by 21 ft. 9 in. in the prime vertical. The Meridian Circle Room, situated to the west of the former, communicates with it by two doors. It is 34 ft. 3 in. by 15 ft. 6 in., and contains the piers for the Meridian Circle and its two collimators; the instrument is situated somewhat to the south of the centre of the room.

The walls of the building are of stone, containing a number of louvred windows to allow circulation of air between the outside walls and the inner lining. The latter is of galvanized iron, and covers the whole of the outer walls except the observing slits. The roof is a flat concrete one; between it and the galvanized iron ceiling is

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an air-space of about two feet, through which the outer air circulates freely by means of a number of small louvered openings. Ventilation of the room itself, when the observing slits are closed, can be controlled by a number of shafts which pierce the walls, terminating just above the floor in registers which may be opened or closed as desired. The observing slits, which extend downward to within three feet of the floor, are three feet in width; they are closed by vertical doors in the walls, and by shutters on the roof. The opening mechanism for these, which was installed during the past winter, is described below.

As mentioned in my last report, the Meridian Circle piers had suffered upheaval during the winter of 1907-8, shortly after the instrument had been mounted. During the period between the early part of January and the end of March the level error changed from about ten seconds to nearly six minutes of arc. During the next two weeks it rapidly decreased to about two and a half minutes, and thereafter continued decreasing with a gradually diminishing rate; by the middle of May it had reached a value of about one minute. As the graduated circles had been returned to the makers for repairs there was no convenient means of measuring the change of nadir point, *i.e.*, the angular displacement of the piers in the meridian; it also, however, was no doubt considerable. The collimator piers were also displaced by a number of minutes. The two field-transit piers and the two collimator piers in the Transit Room fared even worse, having all been broken across in the basement a few feet above the floor.

The trouble was evidently due to the action of frost; if further confirmation were needed, it was supplied by an examination of the earth beneath the basement of the Transit Room, which was found to have been saturated with water and frozen. A drain had been provided to carry away surplus water, but the system of drainage was not sufficiently thorough. It was also evident that the foundations of the piers were not sufficiently protected. It was decided that the only satisfactory remedy lay in the reconstruction of all the piers, sinking their bases several feet deeper into the earth, and providing a system of drainage as thorough as could be installed. The matter was taken up by the Department of Public Works, and the demolition of the old piers—an undertaking of considerable magnitude in itself—was begun in May.

It had been previously decided that the azimuth marks for the Meridian Circle should depend on the same principle as those designed by Sir David Gill for the Cape Observatory, the primary marks consisting of lenses fixed some distance underground to ensure stability, while above would be movable marks capable of being adjusted accurately over the optical centres of the underground lenses. A similar arrangement would be required in the case of the collimator piers, to ensure the stability of the long-focus collimating lenses which form a part of the azimuth-mark system. As the original collimator piers had not been designed with this end in view, the necessity of reconstruction afforded an opportunity of so altering the design as to facilitate the introduction of this principle. It was necessary also in this connection to consider the disposition of the collimators. If these were placed in a horizontal line it was found that it would be impossible to obtain a line of sight under them upon azimuth marks at a sufficient distance; nor was it considered advisable to raise the azimuth marks to the horizontal line and, by rendering them intervisible, use them as collimators, on account of the height to which it would then be necessary to build the azimuth piers. It was decided finally to do away with the south collimator, using the azimuth mark in its place, and placing a mounting for the other collimator on the north pier, above the collimating lens of the north azimuth mark. This was also advantageous in another respect, since the southern pier, being required only for the long-focus collimating lens, need not extend so far towards the Meridian Circle, thus increasing the range of reflection observations towards the south; the north collimator would not interfere with those towards the north, on account of its greater distance from the telescope. It is possible, however, that the north collimator may also finally be dispensed with;



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if, as seems likely, the azimuth marks should prove sensibly stable for considerable periods, it will be possible to control the collimation by readings on them, in conjunction with occasional reversals of the Meridian Circle. Determinations of flexure might also be made by means of the azimuth marks, by an interchange of eye and object ends of the telescope. Should this arrangement prove possible it will be of advantage; the lenses of the collimators being of only  $4\frac{1}{2}$  inches aperture, the full aperture of the Meridian Circle is not made use of in readings upon them, and it is perhaps doubtful whether the line of collimation so obtained will coincide exactly with that depending on full aperture.

The footings of the reconstructed piers extend  $16\frac{1}{2}$  feet below the level of the floor. Beneath the transit room is a basement with a concrete floor, which lies 10 feet below the upper floor, so that the transit piers extend  $6\frac{1}{2}$  feet underground; the Meridian Circle and collimator piers, on the other hand, are surrounded with earth to a height of about 10 feet. All the piers are surrounded at the base by drains of broken stone. It was my wish to have these drains continued to within a few inches of the surface, so that there could be no doubt as to the thorough drainage of the piers throughout their whole height; the Public Works Department, however, decided that drainage around the bases would be sufficient, and it was so done.\* On account of the depth to which the piers were sunk, it was impossible to lead these drains to the sewage system; accordingly a special concrete cistern of about 1,000 gallons capacity was built below the level of the piers and the drains were led into this; a pipe leading from the cistern to a motor pump serves to empty it as often as necessary. A float connected to a light rod has been so arranged that the top of the rod may be flush with the basement floor when the cistern is empty; the length of rod projecting through the floor gives a measure of the depth of water in the cistern. The amount of water which collects in the cistern at certain seasons is remarkable; on several occasions this spring, immediately after or during a prolonged heavy rain, it has been filled overnight; this circumstance, coupled with the fact that during periods of dry weather comparatively little water is collected, points to surface water as the source of the accumulation. It would appear that the surface drainage flows down beside the outside walls of the building and so under the foundations, often in considerable quantities; this being the case, there would appear to be serious danger not only of finally blocking up the broken stone drains by accumulated silt, but also of undermining the foundations of the Transit House. This danger could probably be avoided by building a suitable drain to surround the three exposed walls of the building.

The parts of the two collimator piers below the floor are similar. The footings are nine feet by six, the longer side being in the east-west direction. The western part of each pier is penetrated by a vertical pit three feet square, to allow access to the underground lens which will serve as the fixed mark; this part of the pier terminates some six feet below the level of the floor of the Meridian Circle Room, and the opening is covered by two hatchways, between which is packed mineral wool. The main part of the pier tapers upwards to the floor, where it measures three and a half feet in the meridian by two and a half in the prime vertical. Through the centre of this is a vertical shaft about six inches in diameter, extending down to the level of the pit previously mentioned, into which it opens by a small arch. At the bottom of the arch the underground lens will be fastened firmly to the concrete, with space underneath for a basin of mercury. Access is had to these when necessary by the pit at the side, while the necessary readings are taken from above through the small shaft.

Above the floor the piers are dissimilar. The northern one, which is intended to support both collimator and long-focus azimuth lens, is built with an overhang to the north, so as to allow as much space as possible to the south for observation of stars by reflection; the dimensions of the top are 5 ft.  $4\frac{1}{2}$  in. by 2 ft. 4 in. The southern pier,

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\* This has since proved to be inadequate.

which will ultimately be required only for the long-focus lens, tapers from the floor to a size of 20 inches by 28 inches at the top. It will also be necessary, however, to fasten a temporary frame-work to the southern pier to support a collimator until the azimuth mark piers shall have been built.

The foundations of the main telescope piers are intended also to carry a pier which rises to the level of the floor, to support the carriage upon which rests the mercury horizon for observation of stars by reflection. In the original pier this had not been included, but it was found that the cement floor was not sufficiently free from vibration to serve the purpose. This part of the pier is, at the floor level, 10 ft. 6 in. in length by 1 ft. 10½ in. in width, extending 3 feet south of the axis of the Meridian Circle, and 7 ft. 6 in. to the north. The foundation is in the form of a cross, with an extreme length of 13 feet, and width of 10 ft. 6 in., tapering upwards to within a foot of the floor, where the size is 10 ft. 6 in. by 8 ft. The two columns supporting the bed-plates of the instrument are 2 ft. 3 in. square at the floor, tapering to 1 ft. 4 in. at the top, which rises to a height of 6 ft. 2 in. from the floor. The inner faces of the piers, which are vertical, are at a distance of 3 ft. 6 in.

In the Transit Room, the two transit piers and the two collimator piers, the latter forming part of the system of the western transit equipment, extend to the same depth as the Meridian Circle piers; as stated above, however, owing to the basement which underlies this part of the building, they are surrounded with earth to a height of only 6½ feet; the concrete cistern above referred to lies immediately to the south of the eastern transit pier. A floor plan of the Meridian Circle Room and Transit Room, showing the positions of the various piers is given in Fig. 1; sections of the piers are shown in Fig. 2 and Fig. 3.

All the piers are protected above the level of the floor by a layer of thick felt; surrounding this, with the interposition of an air-space, is a casing of wood. These casings, as well as the piers themselves, are of course free from the floor; the space between piers and floor, instead of being vacant, is filled with felt. To promote cleanliness, as well as for increased comfort during the winter months, the original concrete floor has been covered by a wooden one.

To exclude snow from the spaces between the inner and outer walls and above the ceiling it was necessary to have winter coverings for the louvred openings. These were made in the fall of 1908 and have worked satisfactorily during the past winter. They consist of frames to fit on the outside of the openings, covered with copper wire gauze of a fairly fine mesh; for protection against accidents this is covered by a somewhat heavy galvanized iron mesh. It has been found that these, while affording a reasonable circulation of air, exclude the greater part of the snow; if a little snow drifts through, it is caught by the louvres and prevented from penetrating to the space inside the walls. To ensure a freer circulation of air during the summer, the frames are removed in the spring.

The roof shutters for covering the observing slit are divided into three sections in the case of the Meridian Circle, and into two in the case of each of the transit slits. An opening mechanism had previously been applied to the central section in the Meridian Circle Room; that for the other six sections was installed during the past winter. The mechanism works on the same principle as that at Greenwich; each section of the shutter is supported by the outer ends of two curved arms which are fastened by key-ways on a shaft hung in bearings parallel to the slit; the other ends of these arms carry counterpoises approximately equal in weight to the shutter. Keyed on the shaft is another arm extending horizontally nearly to the wall, and connected by another nearly vertical jointed arm to a winch on the wall, which serves to open or close the shutters by turning a handle. The joint between every two sections is covered by an independent flap, which is raised by either shutter indifferently; the flap is prevented from falling back when open by a flat curved spring which presses against it near the hinge, and starts it down with the shutter when the latter is being closed.

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The vertical wooden wall-shutters, six in number, have been made in two sections, closing respectively the lower and upper halves of the observing slits in the walls. Both sections open outwards; either the upper section alone, or both, may be opened; the lower section, however, can not be opened alone; in general only the upper section need be open, except for reading on azimuth marks. The upper section is controlled by a rod bent at right angles near its upper extremity, and fastened by a flexible joint nearly in the centre of the shutter; when closed the horizontal part of the rod passes over a hook on the shutter and the vertical part springs into place between two hooks on the casement, holding the shutter firmly closed; when open it is held in a similar manner.

The difference of longitude between the middle of the observing slit in the Meridian Circle Room and the pier in the old transit hut was measured January 20, 1909. A theodolite was set up to the south of the old hut and set on the transit wires; the azimuth of a point on the wall of the transit annex was measured from this point and the distance chained. The resulting longitudes of the Meridian Circle and of the centres of the two transit piers, referred to the old pier, are as follows:—

|                       |            |           |           |
|-----------------------|------------|-----------|-----------|
| Meridian Circle,      | 214.9 ft.  | . . . . . | .201 sec. |
| Western transit pier, | 199.9 ft.  | . . . . . | .187 "    |
| Eastern transit pier, | 188.65 ft. | . . . . . | .176 "    |

The approximate latitude of the Meridian Circle, as obtained from a few pairs of stars observed in August, 1908, is  $45^{\circ} 23' 37''.6$ ; this may be in error by several tenths of a second.

The positions of the azimuth marks for the Meridian Circle were laid down in the early part of last summer. The line of sight to the north mark passes through the pinery immediately to the north of the Observatory; the pier will be situated just beyond the top of a ridge running in the east-west direction, and within about 30 feet of the road which forms the southern boundary of the city; its distance from the collimating lens will be about 250 feet. It was originally intended to have the south azimuth mark, if possible, at a distance of about 300 feet, situated on the other side of the driveway which runs in a northwest-southeast direction past the western end of the Observatory. As this ground belonged to the Department of Agriculture it was necessary to have its consent to the erection of the mark, and this unfortunately proved impossible. It was therefore necessary to locate the mark on the grounds of the Observatory; as the line of sight of the Meridian Circle crosses the above-mentioned driveway at an angle, the greatest distance obtainable was about 160 feet.

The piers and the buildings to protect them have been planned, but no provision has as yet been made for their erection.

## THE MERIDIAN CIRCLE.

No observations were made with the Meridian Circle during the period covered by this report. The year has been occupied with the many alterations which were found necessary before the instrument could be got into condition to do creditable work. There is scarcely an essential part of the instrument which has not required alteration in at least some detail. Much of this work has been done; much still remains to do. It is hoped, however, if the repairs which still remain can be completed in the workshop in time, to be able to begin regular work in both right ascension and declination about the beginning of 1910.

The graduated circles, which had been returned to the makers for repair of damages sustained in shipping, were received in June. They were immediately mounted and their planeness tested by the same method as used previously, as described in my last report. It was found that the extreme deviation of the fixed circle from a true plane at right angles to the axis was now about .001 inch; that of the movable

circle was, however, .006 inch, a quantity large enough to throw the microscopes very slightly out of focus at the extreme points. It was also discovered that on reversing the instrument the microscopes were no longer in focus; in fact, the circles were unsymmetrically fixed on the axis by about one twenty-fifth of an inch; it developed later that this was at least partly due to the fact that in truing up the fixed circle, not only had the band carrying the graduations been turned down but also a cut had been taken off the bearing on the other side of the circle, without any compensating alteration on the movable circle.

To rectify the latter point, it would appear to be immaterial whether the circle were set farther out on the axis, or the end of the pivot shortened, or, what amounts to the same thing, the other pivot lengthened; the desideratum being that the distance from plane of graduations to end of pivot should be the same for both ends. Accordingly, as being the easiest undertaking, a bushing of hardened steel was made to fit into the hollow of the pivot corresponding to the movable circle, carrying a disc of the required thickness which fitted against the end of the pivot. This worked fairly satisfactorily, but as will be seen below, another alternative was adopted later.

With regard to the other error of the circles, which we may for brevity designate the deviation from mean plane, it may be composed of two parts—(1) a divergence of the average plane of the graduations from true perpendicularity to the axis; (2) a deviation of the graduated band itself from the true plane form; the former may be remedied by alteration of the bearing surfaces between circles and axis, the latter only by re-graduation. If  $p$  be the perpendicular distance of the object glass of any microscope from the graduated band, and  $d$  the distance of the graduation set upon from the centre of the field, then the measured angle will be

$$\theta = \frac{d}{p}.$$

Differentiating with respect to  $\theta$  and  $p$

$$\delta \theta = -\frac{d}{p^2} \delta p = -\theta \frac{\delta p}{p}.$$

Hence the error in the angle measured by one microscope is proportional to that angle and to  $\delta p$ , which is the deviation from mean plane of the circle at that point. The maximum effective value of  $\theta$ , provided settings of the telescope are made without regard to the position of the division marks in the field of the microscopes, and provided also that only one division mark is set on for each setting of the telescope, will be the same as the interval between successive graduations, in this case 5'; also the value of  $p$  is 2.7 inches. Thus if  $p$  be .001 inch, the maximum error arising from this source of an angle measured by one microscope will be .11". Further, this will be practically a constant error for any particular star, except as influenced by reversal of the instrument and more particularly by alterations of the position of the circle on the axis. If, however, as is practically always the case, angles be measured by a pair of opposite microscopes, the part of this error due to lack of perpendicularity of graduated band and axis will be eliminated,  $p$  being of opposite sign for the two microscopes. That part, however, which depends on deviations of the graduations from a true plane, will still remain; if the deviations are due to a simple bend of the circle along a diameter the effect will be reduced, though not eliminated, by reading four microscopes. It may be noted here that the error  $\delta\theta$  varies inversely as  $p$ ; hence the advantage of long focus microscopes; those on this instrument are probably too short.

All errors arising from deviation from mean plane may be eliminated by setting exactly on division marks, throwing the brunt of the measurement on the declination micrometer. In this case it is sufficient if the circles are nearly enough true that the graduations may be always in focus. This must, however, be qualified by the recollection that focal lengths, &c., vary with temperature; hence it is desirable even in this

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case that the circles should be as true as possible, in order that the necessity of re-focussing may be reduced to a minimum.

Having regard to these facts, it was decided in the first place to attack the adjustment of the movable circle, as being the one most requiring it; it was also decided that the only feasible method lay in scraping the bearings between circle and axis, in conjunction with tests by a surface-plate. In order to save time, since the reconstruction of the piers in the meridian circle room was being proceeded with, it was decided to erect temporary piers outside for the necessary tests, and to shelter them by a wooden hut. In the meantime a special surface plate in the form of a ring was constructed, in order to make the necessary tests for flatness of the bearing on the axis against which the circle was clamped.

As before, the lower southern microscope on the western pier was replaced by a steel rod sliding in bearings, one end of which could be brought into contact with the graduations when desired. A mark on this was set on with the microscope, which had been mounted with its axis perpendicular to the rod. Readings were taken at every  $30^\circ$  around the circle; the latter was then shifted  $90^\circ$  on the axis and the process repeated; the same was done for positions of the circle  $180^\circ$  and  $270^\circ$  from its initial position.

Assume in the first instance that the graduations all lie in one plane; also that the bearing surface on the circle and that against which it engages on the axis are true planes. Let the angle between the axis of the telescope and the normal to the surface of the bearing on the axis be  $a''$ , and let the plane containing these two lines intersect the position of the lower southern microscope when the pointer reading on the fixed circle is  $\varphi$ . Also let the normals to the plane of the graduations and the plane of the circle bearing (on the movable circle) include an angle  $b''$ , and, for the initial position of the movable circle, let  $X$  be the pointer reading on the fixed circle when the plane containing these two normals cuts the lower southern microscope. Then, for the position of the telescope corresponding to a pointer reading  $\theta$  on the fixed circle, the displacement from its mean position of the graduated band (on the movable circle), as measured by the microscope, will be

$$a \cos (\theta - \varphi) + b \cos (\theta - X).$$

Taking a series of readings at intervals of  $30^\circ$  around the circle, and diminishing each by the mean of all, we shall have twelve equations of the form,

$$a \cos (\theta - \varphi) + b \cos (\theta - X) = m,$$

$\theta$  having the values  $0^\circ$ ,  $30^\circ$ ,  $60^\circ$ , &c. For the second position of the circle we have twelve equations of the form

$$a \cos (\theta - \varphi) + b \cos (\theta + \frac{\pi}{2} - X) = m',$$

and similarly for the two remaining positions. From these 48 equations we may determine  $a$ ,  $b$ ,  $\varphi$  and  $X$  with considerable accuracy, thus obtaining a complete knowledge of the magnitude and location of the errors considered. Further, by substituting the values so found in the observation equations, we may from an examination of the residuals determine by how much the circle departs from the plane form.

The first test with the new surface plate showed a high spot at one point on the axis bearing; when this had been scraped off the deviation of the circle was considerably lessened. The first set of measurements after this had been done gave a value of  $9''$  for  $a$  and about  $4''$  for  $b$ ; in one position of the circle on the axis this corresponds to a variation of over .002 inch, exclusive of irregularities. It was found also that the circle was distorted by the pressure of the screw collar which holds it against the axis, so that when the collar was forced home the irregularities reached a value of  $7''$  on each side of the mean, as against about  $4''$  when it was only moderately tight; this was found to be due to the fact that the circle bearing was not a plane; the same was true of the face of the screw collar and the face on the circle against which it bore.

For these latter, since the only requirement was that they should be plane, one scraping, in conjunction with tests by a surface plate, was sufficient; in the case of the bearings between circle and axis, however, on account of the difficulty of knowing just how much was taken off at a time, it was necessary to proceed by trial, taking care that both surfaces should always be plane when measurements were taken. In this way, after some half dozen trials, the values of  $a$  and  $b$  were each reduced to about 1".

Some preliminary measurements had previous to this been made for determination of pivot error; it had been assumed without testing that the pivots were hardened; it was accidentally discovered, however, about the end of August, while the adjustment of the circles was still going on, that this was not the case. Such a serious defect as this had not been anticipated, though considering the many other imperfections of the instrument it should perhaps not have proved surprising.

After consideration, it was decided to turn the pivots down to a smaller size, and to force over them hardened steel bushings of the original diameter (4 inches). We were much handicapped by lack of previous experience in such operations, and by the lack of machines large enough to accommodate the axis, but after several failures have finally succeeded in obtaining pivots which give every promise of being satisfactory.

As the lathe at the Observatory was not large enough for the purpose, the axis was taken to a machine shop in the city, and the original pivots turned down to a diameter of about  $3\frac{1}{2}$  inches; they were then carefully ground with a very slight taper, to facilitate the forcing on of the bushings. Here again difficulty was encountered, as nowhere in the city was there a grinder capable of accommodating the instrument; inquiries in Montreal and Toronto were equally unavailing. The grinding was finally done in a lathe, by fastening a small portable motor-driven cutter-grinder in the tool-post of the lathe. The first bushings were made from forgings obtained from a local firm; after turning, boring and hardening these, they were ground inside to the required taper, and outside to very nearly the finished size, and then forced over the ground surfaces on the axis. They were then reground, and finished by using flour emery in a circular lap of gun-metal. Not until this final process was reached was it discovered that the metal was permeated by minute flaws which made the attainment of a perfect surface impossible.

At this stage Messrs. Warner and Swasey, the well known instrument makers of Cleveland, were communicated with; in their reply they very kindly gave a complete description of the processes they employed in finishing pivots. The details of the process were practically the same as had been followed here, with the exception that they advised making the bushings not from forgings, but from blocks cut out of bar steel, to insure as far as possible homogeneity and freedom from strains and flaws. Accordingly a bar of steel was obtained and new bushings made from it; on this occasion the use of the workshop at the Royal Mint, where large lathes were available, was very kindly offered by Mr. Cleave, and was thankfully accepted. Trouble was again experienced with the lapping, it being found impossible to get a satisfactory surface. The Observatory mechanician, Mr. Mackey, who has had long practical experience in all kinds of machine work, finally gave it as his opinion that the difficulty arose from the small inequalities left in the surface by the portable grinder employed, the machine not having sufficient rigidity to ensure an even surface; as a matter of fact this proved in the end to be the case.

One of the machines at the Mint is a large grinder, sufficiently long to carry the meridian circle axis, but capable of swinging only fourteen inches, while the largest diameter of the axis is eighteen inches. This machine Mr. Cleave very readily permitted to be altered by raising the centres to a sufficient height; in fact the work in connection with the alteration was all performed at the Mint, and nearly all by his own workmen. When this had been done, the pivots were re-ground in it, and no further trouble was experienced in the lapping. At the same time, the tapered bearings on which the circles fit, were tried up, as a slight eccentricity with respect to the

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new pivots had been introduced; this made it necessary also to turn a corresponding amount off the faces against which the circles are clamped. During the process a small cut was also taken off the end of one pivot, to eliminate the asymmetry mentioned above in the positions of the circles.

In this connection I wish to express my appreciation of the very great kindness of Mr. Cleave in practically placing his whole workshop at our disposal. Had it not been for his generous offer the work could hardly have been done in Canada.

As stated above, a great deal of work still remains to be done on the instrument. The two bearings on the axis, against which the circles are clamped, will doubtless require to be scraped, as will also the bearing on the fixed circle; this alone will require considerable time. The counterpoises are very unsatisfactory; a weight of about 350 pounds is at present counterpoised through a lever system by 10 pounds; with such a multiplication factor, especially with the arrangement used, the friction is so great as to prohibit effective control of the weight resting on the pivots; new counterpoises will require to be made. The right ascension micrometer, or rather the eye-piece slide driven by it, does not work freely, and will require overhauling. Several of the micrometer slides in the circle microscopes do not work freely; the springs in these are also unsatisfactory. The double spider lines in right ascension and declination micrometers and circle microscopes are at unsuitable and varying distances, and will require to be renewed. Besides these, there are many other details which require attention. The necessary alterations can best be made at the Observatory, where personal supervision will be possible; as, however, the machine shop is always overcrowded with work, it may take considerable time.

The observing couch, which was ordered some time ago, has been received. It is of somewhat different design from the ordinary form, and is intended to afford facility for quick setting in any desired position, together with the possibility of easy adjustment after the observer has taken his place upon it. Four wheels, running upon the same tracks as the reversing carriage, carry a wooden frame-work which in its turn supports a central transverse axis. On the latter is pivoted a light steel frame, which is also supported near one end by two screws connected with the wooden frame-work; by rotating these the frame may be tilted through a small angle in either direction. On the same axis are mounted two movable leaves; each of these is supported near its outer end by two rack sectors which engage pawls fastened to the steel frame; the pawls engage in the racks by their own weight, but may be released by a conveniently placed handle. The slow-motion screws are connected by means of a sprocket chain and bevel gears with two hand-wheels mounted one at each end of the transverse axis. The leaves of the couch can thus be quickly set in the approximate position required by means of the sectors, and after the observer has taken his place upon the couch he can tilt the whole upper frame into the proper position by means of the hand-wheels, which are always within easy reach. This slow motion has been found in practice to be a great convenience.

#### TRANSIT OBSERVATIONS.

Observations with the portable Cooke transit were conducted during the greater part of the year, as heretofore, in the temporary transit shed at the eastern end of the Observatory. About the end of January, however, the instrument was moved to the new Transit Room and set up on the western pier, where it has since remained. The difference in longitude between the new pier and the old is 199.9 feet, or .187 sec.

Observations were made on 142 nights, involving 281 determinations of clock error, as well as some observations for other purposes; on a number of nights two, and sometimes three, observers worked simultaneously, for determination of personal equation. The observations throughout the summer were principally for the purpose of longitude determinations at different points. As clock exchanges were frequently required with two different stations on the same night, sometimes at intervals of an

hour or two, it would have been troublesome to arrange the observing so that it would not conflict with the exchanges. For this reason the two features were kept independent throughout the season, a separate chronograph being used for the exchanges; the latter were held at the hours most convenient to the field observers, irrespective of observations or weather conditions at Ottawa; whenever possible two determinations of clock error were made on every night, preferably, but not necessarily, about the time at which the exchanges were held; for nights on which no observations were obtained the clock error was interpolated from the two adjacent nights. This arrangement, which is of course permissible only with a clock of demonstrated reliability, has proved quite sufficiently accurate for all ordinary purposes; in the case of very important stations the interpolation from night to night might perhaps not be advisable; the independence of observations and exchanges is of advantage, especially on nights broken by clouds, in that it frees the observer from the interruptions and delay inseparable from an exchange. The number of exchanges was 156, occupying 116 nights; the observing was divided among Mr. Nugent, Mr. Smith and myself, the greater part being done by the two former. A first computation of the observations was made by Mr. Tobey; they were then recomputed by the observers, and a final check including occasional recomputations was made.

The accuracy of determinations of level error during the summer was not up to standard. Early in the season the tip was broken off the level vial belonging to the transit; as no other good vial was available, and as several months were required before delivery of a new one, it was necessary to seal up the old one and continue using it. Though the mean value of a division was practically unaltered, it was found that the bubble had become rather sluggish and uncertain in its action, and considerable trouble was experienced with measurements of level error during the whole summer. The apparent probable error of a complete determination of level (comprising usually six independent measurements) was .011 sec.; that for 1907 was .006 sec., and for the spring of 1909, after renewal of the vial, .005 sec. This difference has probably quite an appreciable effect on the accuracy of the work.

The fluctuations in azimuth throughout the summer were reasonably small; adjustments in level were, however, frequently necessary; another peculiarity of the level error was its tendency to progressive change during the evening's work, the western end of the instrument usually rising as the evening progressed; usually a compensating change took place in the opposite direction during the day, though the general tendency of movement throughout the summer was in the former direction. The average rate of elevation of the western pivot was .017 sec. (of time) per hour; the rate varied between -.016 sec. and 0.73 sec. per hour, being negative on 16 nights out of 89. There was no apparent connection between change of level and change of temperature during the hours of observation.

The method of observation was that described in my last report; a set consisted of seven or eight southern stars well up towards the zenith, combined with three or four north stars between  $70^{\circ}$  and  $80^{\circ}$  declination; the telescope was reversed during the observation of each star; as a rule only one group of observations on each star was taken in each position of the instrument. The star-list used contained all the stars in Newcomb's Fundamental Catalogue between  $10^{\circ}$  and  $40^{\circ}$  and between  $70^{\circ}$  and  $80^{\circ}$  declination; the places of the Berliner Jahrbuch were used for all stars contained therein; for the other stars the places were taken from the Nautical Almanac, the *Connaissance des Temps* and the American Ephemeris without the application of any systematic correction; as the number of such stars was not very large, and as substantially the same list was used for the field observations, any resulting errors in the longitudes deduced would be small.

In the same way as described in my last report, the average discordance between two sets observed on the same night (after allowing for clock-rate) was used as a measure of accuracy; from this quantity the probable error of a single set may be



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deduced as follows:—The chance of an error  $x$  occurring in the first set on any particular night is

$$\frac{h}{\sqrt{\pi}} \cdot e^{-h^2 x^2} \cdot \delta x,$$

where  $h$  is the measure of accuracy, and  $\delta x$  is the smallest quantity measured. Similarly the chance of an error  $x + z$  occurring in the second set is

$$\frac{h}{\sqrt{\pi}} \cdot e^{-h^2 (x+z)^2} \cdot \delta x.$$

The chance of both errors occurring on the same night is the product of these quantities; if we take into account the case where an error  $x - z$  occurs in the first set and an error  $x$  in the second the chance is doubled. Hence the number of pairs of errors  $x$  and  $x + z$  occurring in  $N$  nights is

$$2 N \frac{h^2}{\pi} \cdot e^{-h^2(2x^2 + 2xz + z^2)} \cdot \delta x \cdot \delta z.$$

Hence the number of discordances  $z$  (irrespective of sign) occurring in  $N$  nights is

$$2 N \frac{h^2}{\pi} \cdot e^{-\frac{h^2 z^2}{2}} \cdot \delta z \int_{-\infty}^{+\infty} e^{-h^2(\sqrt{2} \cdot x + \frac{1}{\sqrt{2}} \cdot z)^2} \cdot \delta x$$

$$\text{or } N h \sqrt{\frac{2}{\pi}} \cdot e^{-\frac{h^2 z^2}{2}} \cdot \delta z.$$

Hence the sum of all discordances is

$$N h \sqrt{\frac{2}{\pi}} \int_0^{\infty} e^{-\frac{h^2 z^2}{2}} \cdot z \, dz = \frac{N}{h} \sqrt{\frac{2}{\pi}},$$

and if the average discordance be denoted by  $\Delta$  we have

$$\Delta = \frac{1}{h} \sqrt{\frac{2}{\pi}}.$$

But the probable error  $r = \frac{.4769}{h}$ ; hence  $r = .5978 \Delta$ .

In the third column of Table I. are given the clock corrections obtained from each set throughout the summer; the fifth column gives the discordance (after allowing for clock rate) in every case where two sets were taken by the same observer on a single night; the average of all the discordances is .033 sec., being practically the same for all three observers; the probable error deduced from this is .0197 sec. The value of  $\Delta$  deduced in my last report for the old method of observation was .039 sec., corresponding to a probable error of .0233 sec.; as the weight, or efficiency, is inversely proportional to the square of the probable error, the increase of efficiency indicated is 40 per cent; and presumably this has arisen from the alterations in methods of observation and grouping of stars.

As stated above, however, the probable error of the measurement of level was .011 sec. in 1908 as against .006 sec. in 1907 and previous years. If we assume that this effect enters for its full value in the observations of 1908, we should, for a proper comparison, reduce the probable error of a set for the latter year accordingly; that is, we would have a probable error of .0174 sec. for 1908, as against .0233 sec. for previous years, an increase in efficiency of about 80 per cent.

TABLE I.—TRANSIT OBSERVATIONS IN 1908.

| Date.            | Time. |    | T     | Observer* | Discordance. | ± T <sub>0</sub> |
|------------------|-------|----|-------|-----------|--------------|------------------|
|                  | h     | m  |       |           |              |                  |
| May 14 . . . . . | 14    | 50 | 2 434 | N         | .033         | 2 355            |
|                  | 17    | 10 | 2 478 | N         |              | 2 399            |
| " 15 . . . . .   | 12    | 50 | 2 466 | C S       | .013         | 2 466            |
|                  | 14    | 40 | 2 488 | C S       |              | 2 488            |
| " 18 . . . . .   | 13    | 10 | 2 761 | C S       | .024         | 2 761            |
|                  | 14    | 55 | 2 793 | C S       |              | 2 793            |
| " 20 . . . . .   | 14    | 45 | 2 960 | C S       | .058         | 2 960            |
|                  | 16    | 30 | 3 026 | C S       |              | 3 026            |
| " 22 . . . . .   | 13    | 25 | 3 270 | S         |              | 3 304            |
|                  | 16    | 25 | 3 287 | C S       |              | 3 287            |
| " 27 . . . . .   | 12    | 50 | 3 843 | C S       | .026         | 3 843            |
|                  | 14    | 40 | 3 878 | C S       |              | 3 878            |
| June 1 . . . . . | 13    | 20 | 4 960 | C S       |              | 4 960            |
| " 2 . . . . .    | 13    | 30 | 5 110 | N         | .014         | 5 031            |
|                  | 16    | 05 | 5 102 | N         |              | 5 023            |
| " 3 . . . . .    | 14    | 30 | 5 017 | C S       | .033         | 5 017            |
|                  | 16    | 40 | 5 055 | C S       |              | 5 055            |
| " 4 . . . . .    | 14    | 15 | 5 250 | N         | .017         | 5 171            |
|                  | 15    | 45 | 5 270 | N         |              | 5 191            |
| " 5 . . . . .    | 13    | 40 | 5 231 | C S       | .042         | 5 231            |
|                  | 15    | 55 | 5 278 | C S       |              | 5 278            |
| " 6 . . . . .    | 14    | 25 | 5 336 | N         |              | 5 257            |
| " 8 . . . . .    | 13    | 45 | 5 323 | C S       |              | 5 323            |
| " 9 . . . . .    | 17    | 05 | 5 553 | N         | .037         | 5 474            |
|                  | 19    | 00 | 5 519 | N         |              | 5 440            |
| " 10 . . . . .   | 13    | 55 | 5 478 | S         | .001         | 5 512            |
|                  | 15    | 30 | 5 480 | S         |              | 5 514            |
| " 11 . . . . .   | 13    | 50 | 5 639 | N         | .003         | 5 560            |
|                  | 15    | 45 | 5 639 | N         |              | 5 560            |
| " 12 . . . . .   | 13    | 55 | 5 559 | S         | .012         | 5 593            |
|                  | 15    | 20 | 5 549 | S         |              | 5 583            |
| " 17 . . . . .   | 14    | 25 | 5 722 | S         | .049         | 5 756            |
|                  | 15    | 40 | 5 773 | S         |              | 5 807            |
| " 18 . . . . .   | 15    | 05 | 5 856 | N         |              | 5 777            |
| " 20 . . . . .   | 16    | 00 | 5 913 | N         | .079         | 5 834            |
|                  | 17    | 55 | 5 995 | N         |              | 5 916            |
| " 21 . . . . .   | 14    | 40 | 6 149 | N         | .026         | 6 070            |
|                  | 16    | 30 | 6 128 | N         |              | 6 049            |
| " 22 . . . . .   | 14    | 45 | 6 120 | C S       | .028         | 6 120            |
|                  | 16    | 05 | 6 151 | C S       |              | 6 151            |
| " 24 . . . . .   | 14    | 25 | 6 302 | C S       | .077         | 6 302            |
|                  | 16    | 00 | 6 228 | C S       |              | 6 228            |
| " 25 . . . . .   | 14    | 35 | 6 418 | N         | .006         | 6 339            |
|                  | 16    | 20 | 6 416 | N         |              | 6 337            |

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TABLE 1.—TRANSIT OBSERVATIONS IN 1908—Continued.

| Date.        | Time. |    | T     | Observer.* | Discordance. | T     |
|--------------|-------|----|-------|------------|--------------|-------|
|              | h.    | m. |       |            |              |       |
| June 26..... | 15    | 40 | 6 408 | C S        | 019          | 6 408 |
|              | 17    | 00 | 6 430 | C S        |              | 6 430 |
| " 27.....    | 17    | 20 | 6 632 | X          |              | 6 553 |
| " 28.....    | 15    | 00 | 6 649 | X          | 045          | 6 683 |
|              | 16    | 15 | 6 607 | X          |              | 6 641 |
| " 29.....    | 14    | 55 | 6 740 | C S        |              | 6 740 |
| " 30.....    | 15    | 05 | 6 910 | X          | 009          | 6 831 |
|              | 17    | 00 | 6 906 | X          |              | 6 827 |
| July 1.....  | 16    | 00 | 6 869 | C S        | 019          | 6 869 |
|              | 17    | 50 | 6 855 | C S        |              | 6 855 |
| " 3.....     | 15    | 15 | 6 963 | C S        | 024          | 6 963 |
|              | 16    | 35 | 6 990 | C S        |              | 6 990 |
|              | 18    | 50 | 6 944 | X          |              | 6 978 |
|              | 20    | 00 | 6 961 | X          |              | 014   |
| " 5.....     | 15    | 05 | 7 066 | X          |              | 7 100 |
| " 6.....     | 17    | 50 | 7 110 | C S        |              | 7 110 |
| " 8.....     | 15    | 30 | 7 261 | C S        | 036          | 7 261 |
|              | 17    | 10 | 7 229 | C S        |              | 7 229 |
| " 9.....     | 15    | 05 | 7 371 | X          | 025          | 7 292 |
|              | 17    | 00 | 7 401 | X          |              | 7 322 |
| " 10.....    | 15    | 10 | 7 388 | C S        | 062          | 7 388 |
|              | 16    | 40 | 7 330 | C S        |              | 7 330 |
| " 11.....    | 17    | 25 | 7 489 | X          | 051          | 7 410 |
|              | 18    | 35 | 7 441 | X          |              | 7 362 |
| " 12.....    | 15    | 40 | 7 423 | X          | 049          | 7 457 |
|              | 18    | 05 | 7 380 | X          |              | 7 414 |
| " 13.....    | 18    | 10 | 7 533 | X          | 022          | 7 454 |
|              | 19    | 25 | 7 514 | X          |              | 7 435 |
| " 14.....    | 15    | 15 | 7 553 | C S        | 058          | 7 553 |
|              | 16    | 30 | 7 498 | C S        |              | 7 498 |
| " 15.....    | 15    | 35 | 7 604 | C S        | 060          | 7 6 4 |
|              | 18    | 00 | 7 610 | C S        |              | 7 610 |
| " 16.....    | 15    | 55 | 7 670 | X          | 077          | 7 656 |
|              | 17    | 35 | 7 593 | X          |              | 7 579 |
| " 20.....    | 17    | 55 | 7 644 | C S        |              | 7 644 |
| " 24.....    | 16    | 35 | 7 593 | C S        | 038          | 7 593 |
|              | 17    | 55 | 7 631 | C S        |              | 7 631 |
| " 25.....    | 16    | 45 | 7 547 | X          | 011          | 7 581 |
|              | 18    | 10 | 7 534 | X          |              | 7 568 |
| " 26.....    | 16    | 05 | 7 508 | C S        | 008          | 7 508 |
|              | 17    | 30 | 7 498 | C S        |              | 7 498 |
| " 28.....    | 17    | 05 | 7 341 | X          | 051          | 7 327 |
|              | 19    | 05 | 7 286 | X          |              | 7 272 |
| " 29.....    | 17    | 15 | 7 271 | C S        | 008          | 7 271 |
|              | 18    | 40 | 7 263 | C S        |              | 7 263 |

TABLE 1.—TRANSIT OBSERVATIONS IN 1908—Continued.

| Date.   | Time. |    | $\Delta T$ | Observer.* | Discordance. | $\Delta T_c$ |
|---------|-------|----|------------|------------|--------------|--------------|
|         | h.    | m. | s          |            |              | s            |
| July 30 | 16    | 35 | 7 289      | N          | 018          | 7 275        |
|         | 18    | 20 | 7 271      | N          |              | 7 257        |
| " 31    | 16    | 50 | 7 258      | C S        | 065          | 7 258        |
|         | 18    | 20 | 7 323      | C S        |              | 7 323        |
| Aug. 2  | 17    | 25 | 7 370      | S          |              | 7 404        |
| " 5     | 17    | 55 | 7 665      | C S        | 088          | 7 665        |
|         | 19    | 15 | 7 756      | C S        |              | 7 756        |
| " 6     | 20    | 50 | 7 701      | N          | 030          | 7 687        |
|         | 22    | 15 | 7 733      | N          |              | 7 719        |
| " 7     | 18    | 25 | 7 767      | C S        | 014          | 7 767        |
|         | 19    | 25 | 7 813      | C S        |              | 7 813        |
| " 9     | 17    | 40 | 7 986      | S          | 050          | 8 020        |
|         | 19    | 15 | 7 940      | S          |              | 7 974        |
| " 11    | 17    | 40 | 8 156      | N          | 040          | 8 142        |
|         | 19    | 00 | 8 119      | N          |              | 8 105        |
| " 13    | 18    | 20 | 8 280      | N          | 002          | 8 266        |
|         | 19    | 55 | 8 286      | N          |              | 8 272        |
| " 15    | 18    | 55 | 8 336      | N          |              | 8 322        |
| " 17    | 18    | 50 | 8 404      | C S        | 005          | 8 404        |
|         | 20    | 05 | 8 411      | C S        |              | 8 411        |
| " 18    | 19    | 40 | 8 427      | N          |              | 8 413        |
| " 19    | 18    | 05 | 8 576      | N          | 069          | 8 562        |
|         | 19    | 20 | 8 509      | N          |              | 8 495        |
| " 20    | 20    | 05 | 8 546      | C S        | 043          | 8 546        |
|         | 21    | 10 | 8 591      | C S        |              | 8 591        |
| " 21    | 18    | 00 | 8 616      | C S        | 007          | 8 616        |
|         | 19    | 20 | 8 625      | C S        |              | 8 625        |
| " 22    | 18    | 30 | 8 620      | N          | 042          | 8 606        |
|         | 19    | 45 | 8 664      | N          |              | 8 650        |
| " 23    | 21    | 20 | 8 608      | S          |              | 8 642        |
| " 24    | 17    | 45 | 8 683      | C S        | 067          | 8 683        |
|         | 19    | 05 | 8 752      | C S        |              | 8 752        |
| " 25    | 18    | 15 | 8 793      | N          | 005          | 8 779        |
|         | 19    | 25 | 8 790      | N          |              | 8 776        |
| " 26    | 20    | 10 | 8 789      | C S        |              | 8 789        |
| " 27    | 18    | 00 | 8 826      | N          | 018          | 8 812        |
|         | 19    | 20 | 8 810      | N          |              | 8 796        |
| " 28    | 19    | 00 | 8 803      | C S        | 006          | 8 803        |
|         | 20    | 05 | 8 811      | C S        |              | 8 811        |
| " 30    | 18    | 30 | 8 833      | S          | 062          | 8 867        |
|         | 19    | 40 | 8 773      | S          |              | 8 807        |
| " 31    | 18    | 10 | 8 859      | C S        | 032          | 8 859        |
|         | 19    | 20 | 8 893      | C S        |              | 8 893        |

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TABLE 1.—TRANSIT OBSERVATIONS IN 1908.—*Continued.*

| Date.   | Time. |    | $\Delta T$ | Observer.* | Discordance. | $\pm T_e$ |
|---------|-------|----|------------|------------|--------------|-----------|
|         | h.    | m. |            |            |              |           |
| Sept. 3 | 18    | 15 | 9.986      | N          |              | 8.972     |
|         | 19    | 40 | 9.019      | N          | 031          | 9.005     |
| " 4     | 18    | 05 | 9.070      | C S        |              | 9.070     |
|         | 19    | 15 | 9.035      | C S        | 037          | 9.035     |
| " 5     | 19    | 40 | 9.076      | N          |              | 9.062     |
|         | 21    | 00 | 9.107      | N          | 029          | 9.093     |
| " 6     | 18    | 30 | 9.030      | S          |              | 9.064     |
|         | 19    | 40 | 9.064      | S          | 032          | 9.098     |
| " 7     | 19    | 40 | 9.110      | N          |              | 9.096     |
|         | 21    | 05 | 9.171      | N          | 059          | 9.157     |
| " 8     | 19    | 55 | 9.199      | C S        |              | 9.199     |
|         | 21    | 05 | 9.186      | C S        | 015          | 9.186     |
| " 11    | 20    | 15 | 9.388      | C S        |              | 9.388     |
|         | 21    | 35 | 9.379      | C S        | 011          | 9.379     |
| " 12    | 19    | 05 | 9.419      | N          |              | 9.405     |
|         | 20    | 50 | 9.386      | N          | 036          | 9.372     |
| " 14    | 19    | 05 | 9.453      | C S        |              | 9.453     |
|         | 20    | 25 | 9.519      | C S        | 064          | 9.519     |
| " 16    | 19    | 10 | 9.561      | C S        |              | 9.561     |
|         | 20    | 15 | 9.499      | C S        | 064          | 9.499     |
| " 19    | 19    | 10 | 9.676      | N          |              | 9.662     |
|         | 20    | 30 | 9.713      | N          | 035          | 9.699     |
| " 20    | 19    | 25 | 9.616      | S          |              | 9.650     |
|         | 20    | 50 | 9.570      | S          | 048          | 9.604     |
| " 21    | 19    | 50 | 9.616      | S          |              | 9.650     |
|         |       |    |            |            |              |           |
| " 25    | 20    | 45 | 9.706      | C S        |              | 9.706     |
|         |       |    |            |            |              |           |
| " 29    | 20    | 25 | 9.813      | S          |              | 9.847     |
|         | 21    | 25 | 9.782      | S          | 033          | 9.816     |
| Oct. 1  | 20    | 50 | 9.906      | C S        |              | 9.906     |
| " 2     | 19    | 55 | 9.994      | C S        |              | 9.994     |
|         | 22    | 10 | 9.958      | C S        | 040          | 9.958     |
|         | 22    | 10 | 9.910      | S          |              | 9.944     |
| " 3     | 20    | 25 | 9.939      | S          |              | 9.973     |
|         | 21    | 35 | 9.933      | S          | 008          | 9.967     |
| " 5     | 21    | 10 | 10.060     | C S        |              | 10.060    |
|         | 22    | 40 | 10.040     | C S        | 023          | 10.040    |
|         | 22    | 40 | 10.017     | S          |              | 10.051    |
| " 6     | 20    | 35 | 10.073     | N          |              | 10.059    |
|         | 22    | 05 | 10.099     | N          | 023          | 10.085    |
| " 7     | 21    | 00 | 10.076     | C S        |              | 10.076    |
|         | 22    | 20 | 10.081     | C S        | 002          | 10.081    |
| " 9     | 19    | 40 | † 366      | C S        |              | † 366     |
|         | 20    | 45 | 417        | C S        | 049          | 417       |
| " 11    | 21    | 00 | 276        | S          |              | 310       |

TABLE I.—TRANSIT OBSERVATIONS IN 1908.—*Continued.*

| Date.            | Time. |    | $\Delta T$ | Observer.* | Discordance. | $\Delta T$ |       |
|------------------|-------|----|------------|------------|--------------|------------|-------|
|                  | h.    | m. |            |            |              |            | s.    |
| Oct. 12          | 20    | 40 | 400        | C S        | 002          | 400        |       |
|                  | 22    | 25 | 401        | C S        |              | 401        |       |
|                  | 20    | 40 | 336        | S          |              | 370        |       |
|                  | 22    | 25 | 363        | S          |              | 397        |       |
| " 13             | 20    | 45 | 454        | N          | 086          | 440        |       |
|                  | 22    | 25 | 371        | N          |              | 357        |       |
|                  | 22    | 25 | 390        | S          |              | 424        |       |
| " 14             | 21    | 50 | 444        | N          |              | 430        |       |
|                  | 21    | 50 | 456        | S          |              | 490        |       |
| " 15             | 21    | 30 | 591        | N          |              | 577        |       |
|                  | 21    | 30 | 520        | S          |              | 554        |       |
| Nov. 21          | 0     | 55 | 2 291      | S          | 088          | 2 325      |       |
|                  | 2     | 35 | 2 382      | S          |              | 2 416      |       |
|                  | 0     | 55 | 2 260      | N          |              | 016        |       |
|                  | 2     | 35 | 2 247      | N          |              |            |       |
| " 26             | 23    | 50 | 2 952      | N          |              | 2 988      |       |
|                  | 23    | 50 | 2 988      | C S        |              |            |       |
| " 29             | 0     | 30 | 3 253      | S          | 002          | 3 287      |       |
|                  | 2     | 20 | 3 259      | S          |              | 3 293      |       |
|                  | 0     | 30 | 3 307      | C S        |              | 002        | 3 307 |
|                  | 2     | 20 | 3 309      | C S        |              |            | 3 309 |
| Dec. 2           | 0     | 20 | 3 664      | C S        | 056          | 3 664      |       |
|                  | 1     | 50 | 3 611      | C S        |              | 3 611      |       |
|                  | 1     | 50 | 3 516      | N          |              |            |       |
| " 5              | 23    | 05 | 3 981      | S          | 009          | 4 015      |       |
|                  | 0     | 55 | 3 994      | N          |              | 4 028      |       |
|                  | 23    | 05 | 3 864      | N          |              | 041        |       |
|                  | 0     | 55 | 3 827      | N          |              |            |       |
| Mean Discordance |       |    |            |            | $\pm$ 033    |            |       |

\* The letters used to denote the observers are as follows:—R. M. Stewart, S; D. B. Nugent, N; C. C. Smith, CS.

† On Oct. 9, owing to a blown-out fuse, the winding circuit of the clock failed for a few minutes; though the pendulum continued to swing uninterrupted, the reading of the clock-face was changed.

‡ The personal equation of N had changed between Oct. 15 and Nov. 21; hence the observations of N are not entered in the last column after Nov. 21.

#### PERSONAL EQUATION.

An examination of the values of clock error for successive days, as given in the third column of Table I., shows that the differences of personal equation are not negligible. This was very clearly seen on plotting the results in a curve, using different coloured inks for each observer; it was also quite noticeable that the personal equation of N had suffered a sudden change between July 13 and July 16. To determine the values of the personal equations the summer was broken up into periods during which the curve appeared most regular; then for any one period the mean of the observations on each night was represented by the observation equation

$$a + bt + ct^2 + e = \Delta T,$$

$t$  being the interval from a fixed epoch,  $a$ ,  $b$  and  $c$  arbitrary constants,  $\Delta T$  the observed clock error, and  $e$  the personal equation of the observer referred to the standard obser-

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ver. It will be seen that this amounts to assuming that the clock-rate, during the period considered, varied uniformly with the time; the periods were so chosen, by inspection of the curve, that this condition should be approximately fulfilled; even if this were not the case the deduced values of  $e$  would still be trustworthy, provided the work of each observer were distributed fairly uniformly over the whole period. After combining the observation equations and deducing the values of  $e$  for  $N$  and  $CS$ , referred to  $S$  as standard, and also of  $a$ ,  $b$  and  $c$ , these values were substituted in the observation equations and the residuals formed. As the average of the residuals for those parts of the summer included in the periods considered was  $.022$  sec., the largest being  $.06$  sec., it follows that the observations are fairly well represented by the formula. The relative personal equations derived for each period, with their probable errors, are given in Table II. From these figures it would appear that during June and July the personal equation of  $CS$  underwent a gradual progressive change; from a consideration of the observations as a whole, however, and considering the fact that, especially in the first period, the observations of  $CS$  were not distributed over the whole period, it was decided to treat the personal equations of  $CS$  and of  $S$  as constant throughout the season, and to assume (as was evidenced by the clock-curve) a sudden change in that of  $N$  about July 15. Combining the results for the whole season on this assumption, the values of personal equation derived are as follows:—

$$CS - S \text{ .034 sec.}$$

$$N - S \text{ .113 sec. up to July 15; afterwards .048 sec.}$$

As will appear below, it seemed likely from some later developments that the absolute personal equation of  $CS$  was nearly zero; for this reason the above results were altered so as to make his observations the standard; the corrections to be applied to the clock errors of each observer were then as follows:—

$$S \text{ .034 sec.}$$

$$N \text{ .079 sec. up to July 15; afterwards } - \text{ .014 sec.}$$

$$CS \text{ .000 sec.}$$

These corrections have been applied to form the last column in Table I.

To obtain the personal equations of the two field observers  $M^*$  and  $J^\dagger$ , some additional observations were made, the field observers occupying a hut immediately to the south of the one in which the home observations were taken. The observations with  $M$  extended from September 14 to October 14; those with  $J$ , who did not return from the field until later, from November 21 to December 5. During a part of this time two of the home observers frequently observed together, in order to strengthen the determination both of their own personal equations and of those of the field observers. This was rendered possible by the fact that the transit used (Cooke I) was fitted with an attachment which caused it to record over every alternate four revolutions (of the micrometer screw) throughout the field; one observer would follow the star over a group of contacts at a considerable distance from the centre of the field, the other over a group somewhat closer; after reversal the same series of observations was repeated in the reverse order; thus the observations of each observer were complete in themselves; the groups of contacts made by each observer were interchanged for alternate stars. Each observer also took an independent series of level readings; as it was found, however, that there was no systematic difference in this regard, the mean of all the level readings was taken in making the reductions.

The observations for  $M$ 's personal equation are collected in Table III.; those for that of  $J$  in Table IV. It is evident from Table IV. that for the November and December observations the personal equation of  $N$  had again suffered a decided change; those of  $S$  and  $CS$ , however, appear to have remained relatively unchanged; consequently in obtaining the personal equation of  $J$  only the observations of  $S$  and  $CS$  have been used.

\* F. A. McDiarmid.

† W. C. Jaques.

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The values of personal equation obtained above for the five observers engaged were applied throughout in the computations for longitude. Though perhaps not as accurate as might be desired, the agreement of the longitudes derived on different nights has been in general improved by their application, and there is at least no doubt of the real existence of personal differences of about the magnitudes indicated. It follows that it is never safe to assume the absence of personal equation with the transit micrometer, as was the tendency for some time after its introduction; though some of the differences involved above are small enough to be neglected except in the most refined work, several of them are of quite appreciable magnitude. They are, however, much smaller than the personal equations ordinarily occurring in key observations.

In considering *à priori* the question of personality with the transit micrometer, it would appear that there are two factors capable of affecting the result. On account of the motion of the star, there may be a tendency always to keep the moveable wire either ahead of or behind the star, irrespective of its apparent direction of motion; the distance between star and wire, expressed in angular measure, might be expected to be somewhat less for the more slowly moving stars, but this tendency would be, to some extent at least, counterbalanced by the greater value (expressed in time) of any particular angular interval for the latter class of stars; thus the tendency would be for the record to be made either too soon or too late by a quantity which might be sensibly the same for stars of all declinations; this is a personal equation of the same kind as the so-called 'reaction-time' in observations by eye and ear or with the telegraphic key, but it might be expected to be smaller. The second factor is the personal error of bisection, by virtue of which an observer may tend always to set the wire either to the right or left of the centre of the star-image which he attempts to bisect; this effect would change sign with the direction of apparent motion, and its absolute value would be proportional to the secant of the declination, changing sign at the zenith and at the pole; it might also be expected to vary with the magnitude. This error is also present in the case of estimation of transits across fixed wires; there is, however, so far as the variation with magnitude is concerned, the difference that in the latter case the tendency is usually to estimate the bisection of a bright star sooner than that of a faint one, irrespective of the direction of motion, while in the case of the transit micrometer, differences of magnitude will presumably simply have the tendency to increase or diminish the error of bisection.

Errors of the first class arise from the motion of the star, but are independent of its direction; those of the second class do not arise from the motion, but (when expressed as corrections to the time of transit) change sign with its apparent direction; the former will affect the time, but not the azimuth; the latter both, but more markedly the azimuth.

It had long ago been noticed by the writer that, for his own observations, it was impossible satisfactorily to combine observations of south stars with those of north stars at both upper and lower culmination; this for the reason that the stars at upper culmination, when combined with the south stars, gave values of clock error and azimuth consistently differing from those derived from the stars at lower culmination. This circumstance was explicable by supposing that the observations were affected by a systematic error of bisection, and by no other hypothesis except that of systematic catalogue error; it was found that the observations could be reconciled by supposing that the wire was set always to the left of the star by somewhat over a second of arc.

During the summer of 1908 it was decided to make some special observations to test, qualitatively at least, the validity of this hypothesis. In order to obtain as many independent tests as possible, several methods of observation were devised. The most obvious of all, the observation of transits of zenith stars facing alternately north and south, was impracticable with the telescope used, since the standards interfered with the proper manipulation of the micrometer wheels. The first method used was the



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measurement of zenith distances; as the telescope was fitted with an erecting diagonal eye-piece, this was comparatively simple. After setting on a star at some distance from the zenith, preferably a slow-moving north star (the micrometer head having been previously turned so that the moveable wire was horizontal), the diagonal eye-piece was turned in either direction about  $45^\circ$  from the vertical plane; on looking into it with the line joining the eyes horizontal, the micrometer wire appeared vertical, the direction of increasing zenith distance being towards the right or left according to the direction in which the eye-piece had been turned. By making a number of settings with eye-piece alternately right and left the error of bisection was readily found. In this method the question is not complicated by the motion of the star, which appears to move *along* the wire, the motion in any case being very slow if high polars be chosen; thus the result is practically the simple error of bisection for a stationary object. By combining the results from different stars the variation depending on magnitude may also be found. The stars principally used were Polaris and  $\lambda$  Ursæ Minoris; with the latter as many as a hundred settings could easily be made at one culmination. Several other stars of high declination were also used, the total number of bisections made being about 400. Observations of a similar kind on Polaris and  $\lambda$  Ursæ Minoris were also made by C. C. Smith.

The other methods used, which were three in number, all depended on the observation of transits. They were as follows:—

I. Observations of the same star (over different parts of the field) were made with the ordinary diagonal eye-piece (erecting), and also with a simple eye-piece of about the same magnifying power; as the apparent direction of motion is altered by interchanging the eye-pieces, the difference in times of transit (reduced to the meridian) was taken to be double the error of bisection. In this case the observations are not made under exactly similar conditions; with the direct eye-piece a movement of the hand-wheels appears, to an observer accustomed to the erecting eye-piece, to move the wire in the wrong direction, and there is no assurance *à priori* that this will not alter the 'lag' effect, if this exists. The definition is also somewhat better with the direct eye-piece, which might tend to diminish the error of bisection in that case; the result might also be affected by the difference in the observer's position. On account of the use of the direct eye-piece, observations were not possible within  $35^\circ$  of the zenith; stars were observed near the equator and near the pole, both above and below. When reduced to equatorial interval it was found that the error of bisection was practically the same for polar and equatorial stars, the difference in times of transit being, as was expected, of opposite sign for north stars at upper culmination. Care was taken to have the magnitudes varied enough to determine the magnitude equation. The whole number of stars observed was 45.

II. Observations of a few equatorial stars were made in the ordinary way, and also with the diagonal eye-piece turned through  $180^\circ$ , so that the observer faced upwards at an angle in looking into it. As before, the error of bisection was taken to be one-half the difference in the reduced times of transit. Theoretically this method is free from objection, as the conditions of observation are the same in both cases; practically, however, the difficulty of observing with the eye-piece down, without a suitable reclining chair, was found to be a very serious objection; only twelve stars were observed.

III. As in the case of the zenith distance observations above, the star was observed with eye-piece both left and right, and also (over another part of the field) in the ordinary way. With eye-piece left the apparent motion of the star was upward, the wire appearing horizontal; with eye-piece right the motion was downward; the mean of these two observations was taken to be free from error of bisection; hence the error for the ordinary observation was derived. The number of stars observed was 43.

In the several methods described above the results are independent of catalogue places, and include both the absolute value of the error of bisection and its variation with magnitude. Computations were also made from the residuals of the southern Berliner Jahrbuch stars occurring in the ordinary observations to determine the magnitude equation in the case of both *S* and *CS*; this involves the assumption that the B. J. places are free from magnitude equation, which is probably very nearly the case. The residual of each B. J. star in a set was diminished by the mean of all; the same was done with the magnitudes; there results for each star an observation equation of the form  $b m = v$ ,  $m$  being the magnitude of the star diminished by the mean magnitude for the set,  $v$  the residual diminished in the same way, and  $b$  the unknown magnitude equation; the reduction to this form enables stars from different sets to be combined indifferently to obtain the value of  $b$ . 170 stars were used in deducing the magnitude equation of *S*, 143 for that of *CS*.

From the observations by *S* and *CS* in October and November, on the nights on which the two observers worked simultaneously with the same instrument, a computation was made of their difference of personal equation and its variation with magnitude, on the supposition that it was wholly due to bisection error. This supposition appeared extremely probable from the fact that of 19 north stars (at upper culmination) and 43 south stars, every one of the north stars gave a negative difference in the sense *S* - *CS*, and every one of the south stars a positive difference. The signs of the differences for the north stars having been changed, each star furnished an observation equation of the form  $a + b m = v \cos \delta$  for the determination of difference of bisection error,  $a$  and  $b$  being the quantities to be determined,  $m$  the magnitude, and  $v$  the observed difference. The 62 equations were combined by least squares, and  $a$  and  $b$  evaluated.

The results of all the observations and computations described above are collected in Table V. In the case of the zenith distances the bisection errors, for the sake of uniformity, have been reduced to their equivalents in time; all the results are expressed in equatorial interval; the bisection error has throughout been considered positive when the wire is set to the apparent left of the star. The inter-agreement of the means is no doubt much closer than might have been expected from the varied nature of the observations and their comparatively limited number. The results, however, point very strongly to the reality of a large bisection error for the observer *S*, and to its variation with magnitude; the agreement for the two observers points to the probability that their personal equations arise almost wholly from this cause. For a set observed at the latitude of Ottawa ( $45^{\circ} 24'$ ), composed of north stars of magnitude 5.5 at declination  $77^{\circ}$  and south stars of magnitude 4 at declination  $25^{\circ}$ , which is about the average composition, the personal equation between *S* and *CS* due to error of bisection, assuming the latter to be  $-.074$  sec.  $- .0129 (m - 4)$ , would be  $-.036$  sec.; the actual value as obtained directly above was  $-.034$  sec. The closeness of this agreement is, however, no doubt partly attributable to chance.

The observations of *N* in October, on the three nights when he worked simultaneously with *S*, appear to follow a similar law, the differences being all negative for the north stars, and nearly all positive for the south stars; for his observations in November and December, however, after the second change in his personal equation, this is not the case. The observations were considered too few to make a definite analysis; his magnitude equation during the early part of the summer, as deduced from the residuals, was  $-.0019$  sec. per magnitude, a practically evanescent quantity.

It may be remarked that transits of stars near the zenith, observed with a broken type telescope, will be free from error of bisection when the telescope is reversed during the observation of each star. For an ordinary telescope the condition of elimination, so far as effect on the deduced clock-error is concerned, is that the sines of the mean zenith distances of south and of north stars should be proportional to the errors of bisection corresponding to their respective mean magnitudes, provided that the

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zenith distances and magnitudes of individual stars do not differ widely from these means. As, however, the fulfilment of this condition, even approximately, would be extremely difficult in actual practice, and as the resulting error varies fairly rapidly with changes in the conditions, the only practical remedy would appear to be the measurement by each observer of his bisection error and the correction of each separate observation for it if large. Observations of both Polaris and  $\lambda$  Ursæ Minoris at a single culmination, by the method outlined above, would be sufficient to determine whether the error and its variation with magnitude were sufficiently large to be taken into account; if so, further observations of the same kind could be made if desired.

In the measurement of azimuth by the transits of close circumpolars, the clock error being supposed known, the error of bisection enters for more than its full value into the deduced azimuth. In this case the error might either be measured directly as above, and a correction applied, or it might be eliminated by observing with eye-piece alternately left and right as described under III, above.

TABLE II.—PERSONAL EQUATIONS OF HOME OBSERVERS.

| Period, 1908.   | CS-S        |        | N-S         |        |              |
|-----------------|-------------|--------|-------------|--------|--------------|
|                 | s           |        | s           |        |              |
| June 1-20       | -.011       | ± .021 | .098        | ± .016 | Preliminary. |
| June 21-July 15 | .025        | ± .014 | .099        | ± .015 |              |
| Aug. 2-31       | .046        | ± .014 | .057        | ± .015 |              |
| Sept. 3-29      | .056        | ± .018 | .077        | ± .019 |              |
| Oct. 1-7        | .050        | ± .016 | .061        | ± .022 |              |
| May 14-July 15  | .034 ± .007 |        | .113 ± .009 |        | Adopted.     |
| July 16-Oct. 15 |             |        | .048 ± .009 |        |              |

TABLE III.—PERSONAL EQUATION OF F. A. McDIARMID.

| Date.         | Time. |    | CLOCK CORRECTIONS. |       |       |       | PERSONAL EQUATION OF M. |       |      |
|---------------|-------|----|--------------------|-------|-------|-------|-------------------------|-------|------|
|               |       |    | M                  | S*    | N†    | CS    | S-M                     | N-M   | CS-M |
| 1908.         | h.    | m. | s                  | s     | s     | s     | s                       | s     |      |
| Sept. 14      | 19    | 00 | 9.444              |       |       | 9.453 |                         | .009  |      |
|               | 20    | 25 | 9.424              |       |       | 9.519 |                         | .095  |      |
| " 16          | 19    | 10 | 9.505              |       |       | 9.561 |                         | .046  |      |
|               | 20    | 20 | 9.493              |       |       | 9.499 |                         | .006  |      |
| " 19          | 19    | 10 | 9.619              |       | 9.662 |       |                         | .043  |      |
|               | 20    | 10 | 9.562              |       | 9.699 |       |                         | .137  |      |
| " 20          | 19    | 20 | 9.565              | 9.650 |       |       | .085                    |       |      |
|               | 20    | 35 | 9.540              | 9.604 |       |       | .064                    |       |      |
| " 21          | 20    | 05 | 9.656              | 9.650 |       |       | .006                    |       |      |
| " 25          | 20    | 45 | 9.684              |       |       | 9.706 |                         | .022  |      |
| " 29          | 19    | 50 | 9.812              | 9.847 |       |       | .035                    |       |      |
|               | 21    | 15 | 9.844              | 9.816 |       |       | .028                    |       |      |
| Oct. 1        | 20    | 05 | 9.918              |       |       | 9.906 |                         | .012  |      |
| " 14          | 22    | 00 | 0.522              | 0.490 | 0.430 |       | -.032                   | -.092 |      |
| Means         |       |    |                    |       |       |       | .020                    | .029  | .028 |
| Weighted mean |       |    |                    |       |       |       |                         | .025  |      |

\*With personal equation + .034 sec. applied.

†With personal equation - .014 " " "

TABLE IV.—PERSONAL EQUATION OF W. C. JACQUES.

| Date   | Time. |    | CLOCK CORRECTIONS |                |                |       | PERSONAL EQUATION OF J. |       |       |     |
|--|-------|----|-------------------|----------------|----------------|-------|-------------------------|-------|-------|-----|
|  |       |    | J.                | S <sup>+</sup> | N <sup>+</sup> | C S   | S-J                     | N-J   | CS-J  |     |
| 1908.  | h     | m  | s                 | s              | s              | s     | s                       | s     | s     |     |
| Nov. 21  | 0     | 55 | 2 319             | 2 323          | 2 246          | ..... | 006                     | - 073 | 009   |     |
| " 26   | 23    | 50 | 2 988             | .....          | 2 938          | ..... | 2 988                   | ..... | 009   |     |
| " 29   | 0     | 30 | 3 259             | 3 287          | .....          | ..... | 3 307                   | 028   | 048   |     |
|  | 2     | 20 | 3 210             | 3 293          | .....          | ..... | 3 309                   | 083   | 099   |     |
| Dec. 2   | 0     | 20 | 3 516             | .....          | .....          | ..... | 3 664                   | ..... | 148   |     |
|  | 1     | 50 | 3 586             | .....          | 3 502          | ..... | 3 611                   | ..... | 025   |     |
| " 5  | 23    | 05 | 3 947             | 4 015          | 3 850          | ..... | .....                   | 068   | - 097 |     |
|  | 0     | 55 | 3 920             | 4 028          | 3 813          | ..... | .....                   | 108   | - 107 |     |
| Means  |       |    |                   |                |                |       | .....                   | 059   | - 082 | 064 |
| Weighted mean from observations of S and C S, 0 061 sec. |       |    |                   |                |                |       |                         |       |       |     |

\* With personal equation + 034 sec. applied.  
 † With personal equation - 014 sec. applied.

TABLE V.—ERRORS OF BISECTION.

| Method.            | Observer. | Bisection Error. |              |
|--------------------|-----------|------------------|--------------|
|                    |           | s                | s            |
| Zenith Distance    | S         | 074              | - 0119 (m-4) |
| Transits I         | S         | 101              | - 0091 (m-4) |
| " II               | S         | 066              | - 0088 (m-4) |
| " III              | S         | 151              | - 0252 (m-4) |
| Residuals          | S         | .....            | - 0118 (m-4) |
| Zenith Distance    | C S       | 033              | + 0000 (m-4) |
| Residuals          | C S       | .....            | - 0038 (m-4) |
| Direct Differences | S-C S     | 074              | - 0129 (m-4) |
| Means.             | S         | 098              | - 0134 (m-4) |
|                    | C S       | 033              | - 0019 (m-4) |
|                    | S-C S     | 074              | - 0129 (m-4) |

TIME SERVICE.

The ordinary work in connection with the Time Service has consisted, as in the past, of the necessary attention to the up-town service, the sending out of time-signals to the telegraph company, dropping of the time-ball on Parliament Hill, supplying of mean and sidereal time by telephone to those requiring it, occasional rating of chronometers, testing of aneroid barometers, &c., together with the maintenance of the clocks and apparatus at the Observatory.

In addition to the daily time-signals to the telegraph company, the beats of the mean-time clock were on one occasion sent to a member of the Geological Survey staff at Blackwater, B.C., several hundred miles north of the main line of the Canadian Pacific Railway. On this occasion the transcontinental copper wire of the Canadian Pacific Telegraph was used as far as Vancouver; the signals were received at Blackwater satisfactorily.

During the winter season, unless required for special purposes, observations for time were taken usually not oftener than once a week, and occasionally at slightly

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longer intervals. When required only for ordinary time-keeping purposes (the clock error not being required more accurately than to within one or two-tenths of a second) this is found amply sufficient with our Riefler Standard Clock.

Some trouble has been experienced with the maintenance of a perfectly uniform pressure within the case of the Sidereal Standard. During May, 1908, a leak at the rate of several millimetres per month developed; by careful resealing this was reduced, though not entirely eliminated; throughout the whole summer and the ensuing winter a practically uniform leak of one millimetre per month persisted; as, however, the leak was uniform, it did not interfere seriously with the performance of the clock; no attempt was made to keep the pressure at its original value by periodical exhaustion, as it was considered that this would interfere with the continuity of rate. In March, 1909, the electric seconds-contact failed; the necessity of dismounting the clock was taken advantage of to have it cleaned and oiled, after which it was again mounted and exhausted to a pressure of 688 millimetres. An analysis of its rate from June to October, 1908, is given in Appendix A below.

Reference was made in my last report to the proposed extension of the Time Service to the Printing Bureau, the Mint and the Archives Building. It was, however, later decided by the Public Works Department not to equip the Printing Bureau at present. A switch-room to contain the apparatus for serving the two remaining buildings was obtained in the Mint, and was fitted up under my supervision by the electricians of the Public Works Department; this work was completed on September 18. The master-clock for operating the dials was the one which had been formerly used in the basement of the Supreme Court Building as primary for the experimental system installed in 1902. For use as a secondary master-clock it required to be fitted with a minute-contact and a synchronization magnet, as well as with the cut-out described in my last report. This was done in the Observatory workshop, and the clock was set up in the switch-room at the Mint for regulation of rate on August 11. On September 19 at noon the dials in the Mint and Archives Building were started; the master-clock was not put under direct control from the Observatory until some little time later.

In the other departmental buildings there have, as usual, been changes and some additions to the dials in operation. The necessary attention to the system has in the main, as heretofore, devolved upon Mr. Robertson; Mr. Nugent has also frequently assisted in this work. Below is a list of the number of clocks in operation in the city and at the Observatory:—

|  | Mar. 31, '09. | Mar. 31, '08. |
|--|---------------|---------------|
| Minute dials—Parliament Building . . . . . | 49            | 46            |
| East Block . . . . .                       | 36            | 35            |
| West Block . . . . .                       | 63            | 61            |
| Langevin Block . . . . .                   | 48            | 48            |
| Post Office . . . . .                      | 20            | 20            |
| Thistle Block . . . . .                    | 2             | 2             |
| Ottawa Electric Co. . . . .                | 1             | 1             |
| Mint . . . . .                             | 16            | ..            |
| Archives . . . . .                         | 7             | ..            |
| Observatory . . . . .                      | 28            | 28            |
| Tower clocks . . . . .                     | 2             | 2             |
| Program clock . . . . .                    | 1             | 1             |
| Seconds dials . . . . .                    | 3             | 2             |
|  | <hr/>         | <hr/>         |
| Total electrically driven clocks . . . . . | 276           | 246           |

9-10 EDWARD VII., A. 1910

|                                  | Mar. 31, '09. | Mar. 31, '08. |
|----------------------------------|---------------|---------------|
| Secondary Master-clocks. . . . . | 8             | 7             |
| Primary clocks. . . . .          | 4             | 4             |
|                                  | —             | —             |
| Total. . . . .                   | 288           | 257           |
|                                  | ==            | ==            |

I have the honour to be, sir,

Your obedient servant.

R. M. STEWART.

**APPENDIX A.**

## RATE OF THE STANDARD CLOCK OF THE DOMINION OBSERVATORY.

R. M. STEWART.

The construction of astronomical clocks has arrived at such a degree of perfection that, for the present at least, it is probably useless to look for much improvement in this direction. Attention requires to be directed more especially to the conditions under which the clock operates, with a view to keeping these as constant as possible. There are three main factors which influence the performance of a clock: (1) rigidity of mounting and freedom from vibration; (2) compensation for or elimination of variations in atmospheric pressure; (3) compensation for temperature.

The Sidereal Standard of the Dominion Observatory (Riefler No. 75) is of Riefler's well known primary type. The whole clock is enclosed in an air-tight glass cylinder to eliminate all changes of air pressure; it may be remarked here that the rate-variation due to barometer, if not eliminated, is very considerable, amounting in the present case to nearly half a second per day per inch change of barometer. The pendulum rod is of the particular composition of nickel-steel known as invar, whose temperature coefficient of expansion is very small. The temperature compensation is effected by a short compound cylinder of brass and steel, upon which the pendulum-bob is supported. The escapement is of Riefler's own type, one of the principal characteristics being that the impulse to the pendulum is given through the suspension spring; it combines many of the advantages of the two best fundamental types, the 'free' and 'gravity' escapements. The winding is electrical, and is operated automatically at intervals of 20 to 30 seconds.

Though the temperature-compensation of a good pendulum is sufficiently accurate for all ordinary purposes, the refinements of astronomical observations make it necessary in addition to keep the temperature to which it is subjected as constant as practicable. It is considered by many authorities that a variation of a degree or two is not attended by any appreciable effects, but in our case the principle has been followed of aiming at a fairly high degree of refinement in temperature control. The temperature of the clock-room as a whole is kept nearly constant by means of a thermostat controlling an electric heater, while a fan keeps the air in constant circulation throughout the room. This, however, was not found to give the refinement desired, and a separate case was built around the clock. The temperature within the case is main-

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tained slightly above that of the room by a Callender Electric Recorder, which controls a small electric heater, the air being kept in circulation as above by a small fan; the maximum variation is of the order of a tenth of a degree centigrade.

A good test of the rate of the clock is given by the longitude operations of the summer of 1908. Observations for clock error were made on every clear night for four and a half months, from the beginning of June\* up to the middle of October; in general at least two independent determinations were made on each night; the total number of nights was 91; three observers took part in the work, two of them observing usually on alternate nights, and the third less frequently.

Owing to the continuity of the work and the accurate running of the clock, it was found possible to compute the relative personal equations of the observers from the regular observations. To do this, the season was broken up into convenient periods, averaging about a month in length, and a rigorous least square computation of the relative personal equations obtained for each; these separate values were combined with the results of some special observations for personal equation, and final values adopted. The application of these quantities to the observations gave clock errors presumably free from relative personal equation. The general rate showed great uniformity throughout the season, with the exception of the latter part of July; as the rate in this period was so evidently anomalous, it has been left out of consideration in what follows.

In computing clock-rates the effect of errors of observations must not be neglected; where the observations from which the rate is computed are separated by only a short interval, the apparent effect of such errors may be considerable; this, however, decreases as the interval is increased. For this reason the rates in Table I, have been computed, as shown, for intervals of five days, so far as the observations would permit. The second column shows the observed daily rate in seconds for each period, the third the difference between each of these observed rates and their mean, the average difference being  $\pm .015$  sec. per day. Assuming a constant change of rate with the time and solving by least squares the rate-formula obtained is  $-.0500 - .00023 (T - \text{Aug. 8})$ ; the rates computed from this formula are given in the fourth column, while the fifth gives the differences between these and the observed rates, the average deviation being  $\pm .013$  sec.

For the sake of comparison with another clock of the same kind, and to show the effect of temperature-control, Table II, gives a similar analysis of the rate of the United States Naval Observatory clock (Riefler No. 70) for a period of three months in 1904, as published by Prof. Eichelberger†; in this case one period of ten days is omitted; the average interval between observations is 4.2 days. As the variation of temperature during this test was considerable, a temperature-term is introduced in the computed rate. It will be observed that the mean deviation from computed rate is almost the same for both clocks; this may be taken to mean that the ideal performance (that is, the best performance of which the clock is capable) is practically the same in both cases; this is of course to be expected from two clocks of the same type and manufacture. So far as actual performance goes, however, they are to be judged by the residuals from mean, and not computed, rate, and here the Ottawa clock has a very decided advantage, its actual performance being reasonably close to the ideal one. The reason is not far to seek; it lies in the absence of temperature-variations and their disturbing effects. It would not be fair to close this comparison without stating that the United States Naval Observatory has now a new clock room, where, I believe, greater attention is paid to temperature control.

As mentioned above, the interval between observations for clock error will influ-

\* The observations made in May were not considered in this paper because the rate was affected by several changes of pressure and a certain amount of direct disturbance due to adjustments and re-sealing.

† Science, 1907, p. 451.

ence the accuracy of the deduced rate, owing to the effect of errors of observation. In general, the residual rate  $V$  (observed minus computed) will consist of three parts:— (1) the actual variation of clock rate  $v_1$ , (2) an apparent part  $v_2$  depending on errors of observation and interval, (3) another apparent part  $v_3$  due to error in the personal equation employed (if the observations have been made by different observers). Hence

$$V = v_1 + v_2 + v_3$$

and, as may easily be shown, if the number of intervals considered be large,

$$[V^2] = [v_1^2] + [v_2^2] + [v_3^2];$$

or denoting the corresponding probable errors by  $R$ ,  $r_1$ ,  $r_2$  and  $r_3$ ,

$$R^2 = r_1^2 + r_2^2 + r_3^2.$$

Now if  $r$  denote the probable error of a single determination of clock-error, and if, on two nights separated by an interval of  $N$  days, there be made respectively  $n_1$  and  $n_2$  determinations of clock error, we shall have for that particular interval

$$r_2^2 = \frac{1}{n_1} + \frac{1}{n_2} \cdot r^2.$$

The value of  $r$  for the observations considered, obtained by an independent method, is .020 sec. Substituting this value and deducing that of  $r_2^2$  for each of the intervals in Table I., and taking the mean, the result is

$$r_2^2 = (.0046)^2.$$

Again, if  $r^1$  denote the probable error of the value of personal equation employed, we have

$$r_3 = \frac{1}{N} \cdot r^1;$$

the value of  $r^1$  is .008 sec.

Also, the value of  $R$  obtained from the residuals in Table I. is .012; hence  $r_1 = \sqrt{R^2 - r_2^2 - r_3^2} = \pm .011$  sec.; this is the probable value of the actual accidental change in (daily) rate from one period of five days to the next.

Proceeding in exactly the same way, but using, instead of five-day intervals, all the observations available, the average interval being 1.47 days, the values of the quantities are as follows:—

$$R = .025 \text{ sec.}$$

$$r_2 = .0183 \text{ sec.}$$

$$r_3 = .0054 \text{ sec.}$$

and hence  $r_1 = .016$  sec.

Hence it appears that a clock is liable to small irregular fluctuations of rate from day to day, it being in the present case an even chance that such fluctuations shall lie within the limits  $\pm .016$  sec.; when, however, the interval is increased, the fluctuations tend to counterbalance one another.

It would appear also that the clock is liable in addition to anomalous changes of rate for longer or shorter periods; from July 16 to July 31 the average rate was  $-.022$  sec., as against .050 sec. for the remainder of the summer. It has been suggested that this is a peculiarity of invar pendulums, due to some not well understood irregularities in the interval constitution of the material; similar effects have been noticed in other Riefler clocks, but the question can hardly be considered definitely settled as yet. Such changes in rate are, however, for astronomical purposes, less objectionable than the irregular ones (here eliminated) due to irregular variations in temperature and pressure.



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TABLE 1.—DOMINION OBSERVATORY CLOCK.

| Date.          | Daily Rate. | O - M | Computed Rate. | O - C |
|----------------|-------------|-------|----------------|-------|
| 1908.          | s.          | s.    | s.             | s.    |
| June 1-6 ..... | 059         | 009   | 065            | - 006 |
| " 6-11 .....   | 061         | 011   | 064            | - 003 |
| " 11-17 .....  | 037         | - 013 | 063            | - 026 |
| " 17-21 .....  | 069         | 019   | 062            | 007   |
| " 21-26 .....  | 072         | 022   | 060            | 012   |
| " 26-31 .....  | 088         | 038   | 059            | 029   |
| July 1-6 ..... | 049         | 001   | 058            | - 009 |
| " 6-11 .....   | 055         | 005   | 057            | - 002 |
| " 11-16 .....  | 046         | 004   | 056            | - 010 |
| Aug. 0-5 ..... | 083         | 033   | 051            | 032   |
| " 5-9 .....    | 072         | 022   | 050            | 022   |
| " 9-15 .....   | 054         | 004   | 049            | 005   |
| " 15-20 .....  | 049         | 001   | 048            | 001   |
| " 20-25 .....  | 042         | 008   | 047            | - 005 |
| " 25-30 .....  | 012         | - 038 | 046            | - 034 |
| " 30-35 .....  | 043         | 007   | 044            | - 001 |
| Sep. 4-8 ..... | 034         | 016   | 043            | - 009 |
| " 8-14 .....   | 019         | 001   | 042            | 007   |
| " 14-19 .....  | 039         | - 011 | 041            | - 002 |
| " 19-25 .....  | 004         | - 046 | 040            | - 036 |
| " 25-31 .....  | 033         | - 017 | 038            | - 005 |
| Oct. 1-6 ..... | 033         | - 017 | 037            | - 004 |
| " 6-11 .....   | 048         | - 002 | 036            | 012   |
| " 11-15 .....  | 061         | 011   | 035            | 026   |
| Mean.          | 050         | ± 015 |                | ± 013 |
| Range.         |             | 084   |                | 068   |

s.  
 Computed rate = 0500 - 00023 (T - Aug. 8).

TABLE II. - U. S. NAVAL OBSERVATORY CLOCK.

| Date.  |       | Daily Rate. | Mean Temp. | O - M | Computed Rate. | O - C |
|--------|-------|-------------|------------|-------|----------------|-------|
| 1904.  |       | S.          | C.         | S.    | S.             | S.    |
| Feb.   | 8-11  | ·019        | 28·37      | ·003  | ·009           | ·010  |
| "      | 11-15 | ·014        | 28·5       | ·030  | ·006           | ·008  |
| "      | 15-20 | ·005        | 28·3       | ·011  | ·002           | ·007  |
| Mar.   | 1-4   | ·026        | 28·2       | ·042  | ·012           | ·014  |
| "      | 4-9   | ·010        | 28·2       | ·026  | ·016           | ·006  |
| "      | 9-16  | ·022        | 28·1       | ·038  | ·018           | ·004  |
| "      | 16-18 | ·043        | 28·1       | ·059  | ·022           | ·021  |
| "      | 18-22 | ·022        | 28·0       | ·038  | ·021           | ·001  |
| "      | 22-25 | ·029        | 28·0       | ·045  | ·024           | ·005  |
| "      | 25-28 | ·002        | 27·7       | ·014  | ·014           | ·016  |
| "      | 28-34 | ·007        | 27·7       | ·023  | ·018           | ·011  |
| Apl.   | 3-5   | ·017        | 27·4       | ·001  | ·009           | ·026  |
| "      | 5-13  | ·002        | 26·9       | ·014  | ·014           | ·012  |
| "      | 13-16 | 026         | 26·5       | ·010  | 021            | ·005  |
| "      | 16-19 | 034         | 26·3       | 018   | 027            | 007   |
| "      | 19-22 | 002         | 26·4       | ·014  | 020            | ·018  |
| "      | 22-31 | 029         | 25·0       | 013   | 077            | ·048  |
| May    | 1-4   | 113         | 24·3       | 097   | 103            | ·010  |
| "      | 4-7   | 082         | 24·1       | 066   | 109            | ·027  |
| "      | 7-12  | ·161        | 24·0       | ·145  | ·109           | ·052  |
| Mean.  |       | 016         |            | ± 035 |                | ± 015 |
| Range. |       |             |            | ·204  |                | ·100  |

$$\text{Computed rate} = \cdot 0161 - \cdot 00103 (T - \text{Mar. } 29) - \cdot 0456 (t - 27\cdot 0).$$

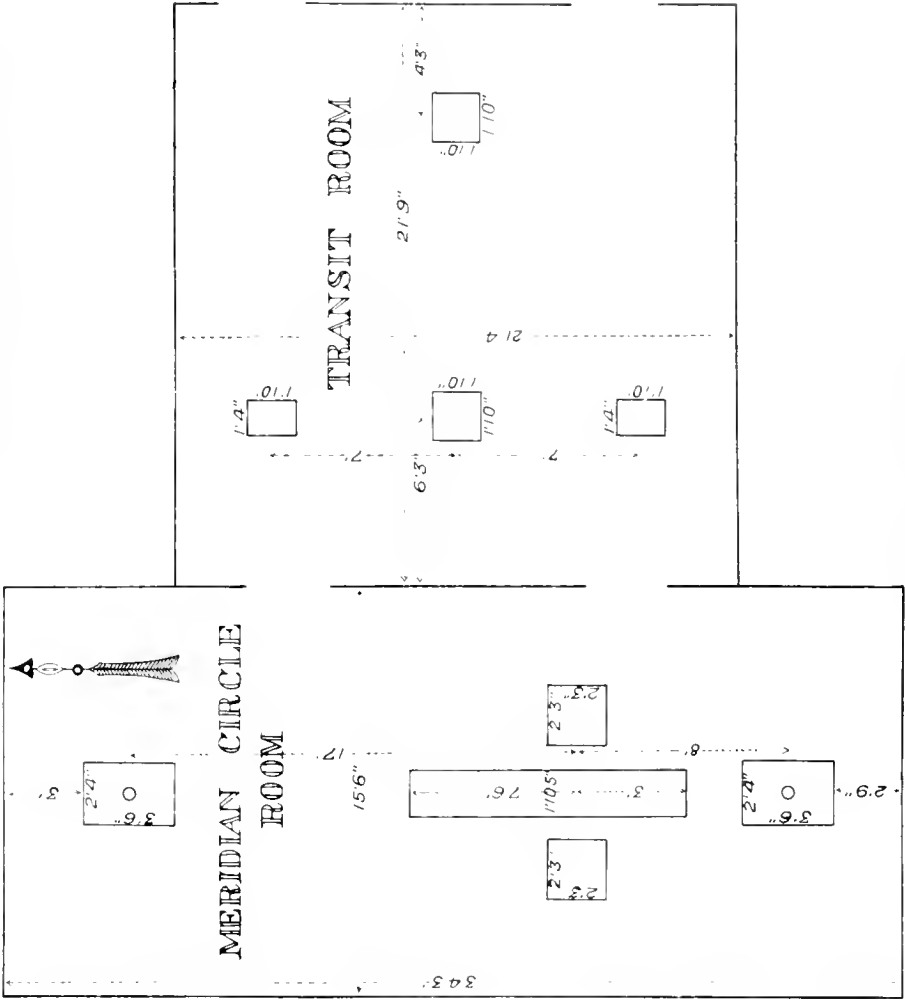


FIG. 1—Floor Plan of Transit Annex



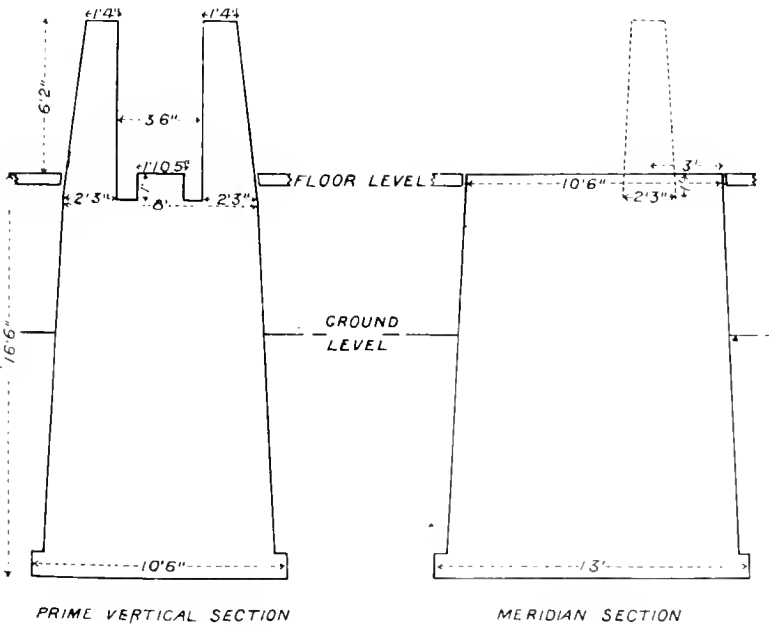
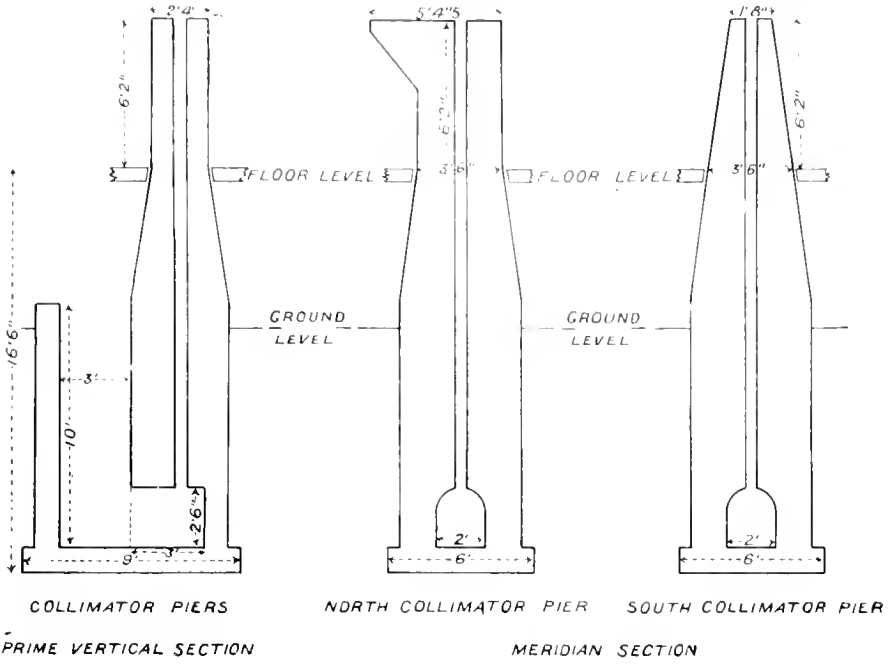
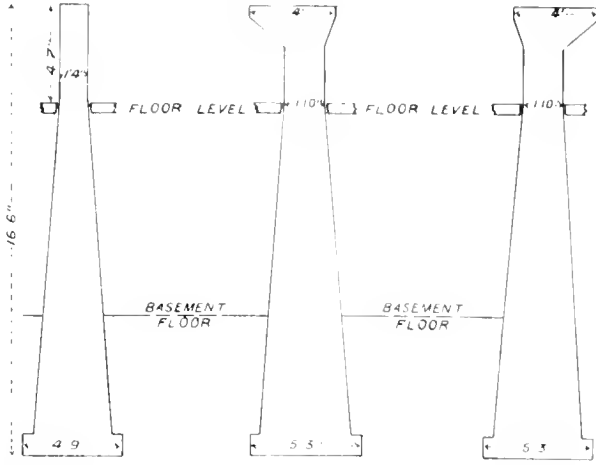


FIG. 2—Piers in Meridian Circle Room.



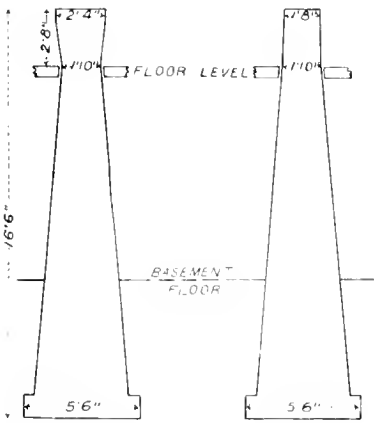
SEWARD MERIDIAN WORK AND TIME SERVICE



COLLIMATOR PIERS NORTH COLLIMATOR PIER SOUTH COLLIMATOR PIER

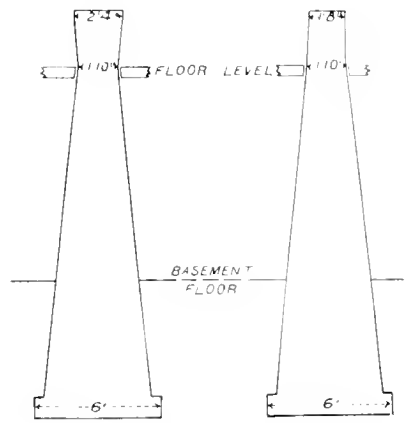
PRIME VERTICAL SECTION

MERIDIAN SECTION



PRIME VERTICAL SECTION MERIDIAN SECTION

WESTERN TRANSIT PIER



PRIME VERTICAL SECTION MERIDIAN SECTION

EASTERN TRANSIT PIER

FIG. 3—Piers in Transit Room.





**APPENDIX 4.**

REPORT OF THE CHIEF ASTRONOMER, 1909.

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**TABULAR STATEMENT OF LONGITUDE  
AND LATITUDE OBSERVATIONS.**

BY

**J. MACARA.**



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MAP.

Map showing position of Astronomical Stations established. . . . .



## APPENDIX 4.

TABULAR STATEMENT OF LONGITUDE AND LATITUDE  
OBSERVATIONS.

DOMINION ASTRONOMICAL OBSERVATORY,  
DEPARTMENT OF THE INTERIOR,  
OTTAWA, CANADA, March 31, 1909.

W. F. KING, Esq., LL.D., C.M.G.,  
Chief Astronomer,  
Ottawa.

SIR,—I have the honour to transmit herewith a tabular statement of the differences of longitude and the latitude results of stations observed in 1908. Annexed thereto is also a description of the stations occupied. A synopsis of the statement giving the longitude and latitude of the various stations will be found on page 619.

The accompanying map shows the position of the various astronomical stations established up to the date of this report.

I have the honour to be, sir,  
Your obedient servant,

J. MACARA.

DIFFERENCE OF LONGITUDE BETWEEN GATEWAY, B. C. AND SEATTLE.

| Date.    | DIFFERENCE OF CHRONO-GRAPH. |    |                  |    | CLOCK CORRECTION. |     |                  |     | DIFFERENCE OF LONGITUDE. |     |                  |    | Time of Trans- mission. |       |    |     |    |    |     |     |
|----------|-----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|-----|------------------|----|-------------------------|-------|----|-----|----|----|-----|-----|
|          | Western Signals.            |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |     | Eastern Signals. |    |                         | Mean. |    |     |    |    |     |     |
|          | m.                          | s. | m.               | s. | m.                | s.  | m.               | s.  | m.                       | s.  | m.               | s. |                         |       |    |     |    |    |     |     |
| 1908.    |                             |    |                  |    |                   |     |                  |     |                          |     |                  |    |                         |       |    |     |    |    |     |     |
| April 27 | 28                          | 51 | 283              | 28 | 51                | 122 | 1                | 729 | 13                       | 715 | 28               | 39 | 307                     | 28    | 39 | 222 | 28 | 39 | 025 | 086 |
| " 28     | 28                          | 50 | 397              | 28 | 50                | 210 | 1                | 952 | 13                       | 073 | 28               | 39 | 256                     | 28    | 39 | 059 | 28 | 39 | 163 | 094 |
| " 29     | 28                          | 49 | 112              | 28 | 48                | 924 | 2                | 899 | 12                       | 698 | 28               | 39 | 313                     | 28    | 39 | 125 | 28 | 39 | 219 | 094 |
| May 3    | 28                          | 45 | 358              | 28 | 45                | 149 | 7                | 078 | 13                       | 142 | 28               | 39 | 294                     | 28    | 39 | 085 | 28 | 39 | 190 | 105 |

h. m. s.  
 28 39 199  
 8 00 274  
 7 40 41 075

Observers: (West—W. C. JAGGER,  
 (East—F. A. McDERMID.)

d A .....  
 A Seattle.....  
 A Gateway.....

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DIFFERENCE OF LONGITUDE BETWEEN BOUNDARY (WANETA) B.C. AND SEATTLE.

| Date.  | DIFFERENCE OF CHRONO-GRAPH. |        |                  |        | CLOCK CORRECTION. |           |                  |        | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Trans- mission. |       |
|--------|-----------------------------|--------|------------------|--------|-------------------|-----------|------------------|--------|--------------------------|--------|------------------|--------|-------------------------|-------|
|        | Western Signals.            |        | Eastern Signals. |        | Western Station.  |           | Eastern Station. |        | Western Signals.         |        | Eastern Signals. |        |                         | Mean. |
|        | m.                          | s.     | m.               | s.     | m.                | s.        | m.               | s.     | m.                       | s.     | m.               | s.     |                         |       |
| 1908.  |                             |        |                  |        |                   |           |                  |        |                          |        |                  |        |                         |       |
| May 13 | 20                          | 11 550 | 20               | 11 400 | -12 552           | -1 34 781 | 18               | 49 321 | 18                       | 49 171 | 18               | 49 246 | 043                     | 072   |
| " 16   | 20                          | 14 271 | 20               | 14 126 | -12 815           | -1 37 742 | 18               | 49 344 | 18                       | 49 199 | 18               | 49 271 | 018                     | 072   |
| " 22   | 20                          | 19 838 | 20               | 19 671 | -13 851           | -1 44 258 | 18               | 49 431 | 18                       | 49 265 | 18               | 49 347 | 058                     | 082   |
| " 25   | 20                          | 22 901 | 20               | 22 747 | -15 025           | -1 48 534 | 18               | 49 392 | 18                       | 49 238 | 18               | 49 315 | 026                     | 071   |
| " 26   | 20                          | 23 732 | 20               | 23 565 | -15 338           | -1 49 722 | 18               | 49 344 | 18                       | 49 191 | 18               | 49 265 | 021                     | 074   |

d A. . . . . h. m. s.  
 A Seattle . . . . . 18 49 289  
 A Boundary . . . . . 8 09 20 274  
 . . . . . 7 50 30 985

Observers ( West—W. C. JACQUES,  
 ( East—F. A. McDIARMID.

DIFFERENCE OF LONGITUDE BETWEEN ST. JOHN, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.  | DIFFERENCE OF CHRONOMETER. |    |                  |    | Clock Correction. |     |                  |     | DIFFERENCE OF LONGITUDE. |    |                  |    | Time of Trans- mission. |       |    |    |     |     |     |
|--------|----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|----|------------------|----|-------------------------|-------|----|----|-----|-----|-----|
|        | Western Signals.           |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |    | Eastern Signals. |    |                         | Mean. | r. |    |     |     |     |
|        | m.                         | s. | m.               | s. | m.                | s.  | m.               | s.  | m.                       | s. | m.               | s. |                         |       |    |    |     |     |     |
| 1908.  |                            |    |                  |    |                   |     |                  |     |                          |    |                  |    |                         |       |    |    |     |     |     |
| May 13 | 38                         | 51 | 225              | 38 | 51                | 121 | 13               | 112 | 38                       | 35 | 836              | 38 | 35                      | 735   | 38 | 35 | 785 | 001 | 050 |
| " 14   | 38                         | 52 | 305              | 38 | 52                | 202 | 12               | 377 | 38                       | 35 | 836              | 38 | 35                      | 733   | 38 | 35 | 785 | 001 | 052 |
| " 15   | 38                         | 51 | 290              | 38 | 51                | 213 | 12               | 477 | 38                       | 35 | 817              | 38 | 35                      | 731   | 38 | 35 | 773 | 010 | 013 |
| " 16   | 38                         | 55 | 284              | 38 | 55                | 193 | 12               | 577 | 38                       | 35 | 796              | 38 | 35                      | 705   | 38 | 35 | 751 | 034 | 016 |
| " 18   | 38                         | 57 | 052              | 38 | 56                | 950 | 12               | 777 | 38                       | 35 | 871              | 38 | 35                      | 778   | 38 | 35 | 825 | 041 | 047 |

Observers: West. D. B. NUGENT, C. C. SMITH.  
East. C. A. FRENCH.

dA ..... h. m. s.  
 EA Ottawa..... 38 35 781  
 EA St. John..... 5 02 51 797  
 EA St. John..... 4 21 16 013



SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN SPRAGUE, MAN., AND DOMINION OBSERVATORY, OTTAWA.

| Date.  | DIFFERENCE OF CHRONO-GRAPH. |    |                  |     | CLOCK CORRECTION. |    |                  |     | DIFFERENCE OF LONGITUDE. |    |                  |    | Time of Transmission |       |     |   |    |    |     |   |    |    |     |     |     |
|--------|-----------------------------|----|------------------|-----|-------------------|----|------------------|-----|--------------------------|----|------------------|----|----------------------|-------|-----|---|----|----|-----|---|----|----|-----|-----|-----|
|        | Western Signals.            |    | Eastern Signals. |     | Western Station.  |    | Eastern Station. |     | Western Signals.         |    | Eastern Signals. |    |                      | Mean. |     |   |    |    |     |   |    |    |     |     |     |
|        | h.                          | m. | s.               | h.  | m.                | s. | m.               | s.  | h.                       | m. | s.               | h. | m.                   | s.    | z.  |   |    |    |     |   |    |    |     |     |     |
| 1908.  |                             |    |                  |     |                   |    |                  |     |                          |    |                  |    |                      |       |     |   |    |    |     |   |    |    |     |     |     |
| June 5 | 1                           | 12 | 30               | 467 | 1                 | 12 | 30               | 201 | 7                        | 05 | 361              | 1  | 19                   | 41    | 683 | 1 | 19 | 41 | 417 | 1 | 19 | 41 | 590 | 019 | 133 |
| " 7    | 1                           | 12 | 25               | 618 | 1                 | 12 | 25               | 357 | 7                        | 10 | 843              | 1  | 19                   | 41    | 751 | 1 | 19 | 41 | 470 | 1 | 19 | 41 | 616 | 041 | 140 |
| " 9    | 1                           | 12 | 24               | 998 | 1                 | 12 | 24               | 712 | 7                        | 11 | 211              | 1  | 19                   | 41    | 669 | 1 | 19 | 41 | 383 | 1 | 19 | 41 | 526 | 013 | 143 |
| " 11   | 1                           | 12 | 23               | 721 | 1                 | 12 | 23               | 436 | 7                        | 12 | 375              | 1  | 19                   | 41    | 656 | 1 | 19 | 41 | 371 | 1 | 19 | 41 | 514 | 055 | 113 |
| " 12   | 1                           | 12 | 21               | 451 | 1                 | 12 | 21               | 127 | 7                        | 11 | 767              | 1  | 19                   | 41    | 806 | 1 | 19 | 41 | 482 | 1 | 19 | 41 | 644 | 075 | 162 |

Observers: West—F. A. McDIARMID,  
East—C. C. SMITH, D. B. NUGENT, R. M. STEWART.

h. m. s. z.  
Ottawa ..... 1 19 41 569  
Sprague ..... 5 02 51 797  
..... 6 22 33 306

DIFFERENCE OF LONGITUDE BETWEEN RAINY RIVER, ONT., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOGRAPH. |    |                  |    | CLOCK CORRECTION. |        |                  |    | DIFFERENCE OF LONGITUDE. |     |                  |    | Time of Transmission. |       |    |        |   |    |        |       |     |
|---------|----------------------------|----|------------------|----|-------------------|--------|------------------|----|--------------------------|-----|------------------|----|-----------------------|-------|----|--------|---|----|--------|-------|-----|
|         | Western Signals.           |    | Eastern Signals. |    | Western Station.  |        | Eastern Station. |    | Western Signals.         |     | Eastern Signals. |    |                       | Mean. |    |        |   |    |        |       |     |
|         | h.                         | m. | s.               | h. | m.                | s.     | h.               | m. | s.                       | h.  | m.               | s. |                       |       |    |        |   |    |        |       |     |
| 1908.   |                            |    |                  |    |                   |        |                  |    |                          |     |                  |    |                       |       |    |        |   |    |        |       |     |
| June 16 | 1                          | 14 | 42.762           | 1  | 14                | 42.490 | 35.753           | 1  | 5                        | 743 | 1                | 15 | 24.258                | 1     | 15 | 23.986 | 1 | 15 | 24.122 | 0.050 | 136 |
| " 19    | 1                          | 14 | 36.517           | 1  | 14                | 36.262 | 41.862           | 1  | 5                        | 826 | 1                | 15 | 24.206                | 1     | 15 | 23.951 | 1 | 15 | 24.079 | 0.007 | 138 |
| " 20    | 1                          | 14 | 34.599           | 1  | 14                | 34.327 | 43.061           | 1  | 5                        | 875 | 1                | 15 | 24.135                | 1     | 15 | 23.863 | 1 | 15 | 23.989 | 0.073 | 136 |
| " 23    | 1                          | 14 | 27.302           | 1  | 14                | 27.004 | 50.737           | 1  | 6                        | 200 | 1                | 15 | 24.237                | 1     | 15 | 23.939 | 1 | 15 | 24.088 | 0.016 | 149 |

OBSERVERS (West—E. A. McDIARMID,  
 (East—R. M. STEWART, D. B. NIJENT, C. C. SMITH.

dA  
 A Ottawa ..... h. m. s.  
 A Rainy River ..... 1 15 24.072  
 A Rainy River ..... 1 15 23.797  
 A Rainy River ..... 1 15 23.869

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN MONCTON, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOGRAPH. |        | CLOCK CORRECTION |        | DIFFERENCE OF LONGITUDE. |          |                  |        | Time of Transmission. |        |     |        |     |
|---------|----------------------------|--------|------------------|--------|--------------------------|----------|------------------|--------|-----------------------|--------|-----|--------|-----|
|         | Western Signals.           |        | Eastern Signals. |        | Western Signals.         |          | Eastern Signals. |        |                       |        |     |        |     |
|         | m.                         | s.     | m.               | s.     | m.                       | s.       | m.               | s.     |                       |        |     |        |     |
| 1908,   |                            |        |                  |        |                          |          |                  |        |                       |        |     |        |     |
| May 21  | 43                         | 12 893 | 43               | 12 741 |                          |          | 43               | 41 967 | 43                    | 42 043 | 010 | s      |     |
| " 22    | 43                         | 14 338 | 43               | 14 182 | + 3 145                  | + 32 371 | 43               | 42 119 | 43                    | 41 976 | 001 | 078    |     |
| June 23 | 43                         | 40 951 | 43               | 40 804 | + 3 296                  | + 31 690 | 43               | 42 132 | 43                    | 41 976 | 43  | 42 054 |     |
| " 25    | 43                         | 18 735 | 43               | 18 575 | + 6 500                  | + 07 334 | 43               | 42 085 | 43                    | 41 938 | 43  | 42 012 | 041 |
| " 26    | 43                         | 08 121 | 43               | 07 956 | + 6 338                  | + 29 762 | 43               | 42 159 | 43                    | 41 989 | 43  | 42 079 | 026 |
| " 27    | 43                         | 10 311 | 43               | 10 185 | + 6 419                  | + 40 495 | 43               | 42 197 | 43                    | 42 032 | 43  | 42 114 | 061 |
| "       |                            |        |                  |        | + 6 553                  | + 38 319 | 43               | 42 077 | 43                    | 41 951 | 43  | 42 014 | 039 |

h m s  
 43 42 053  
 5 02 51 797  
 4 19 09 744

OBSERVERS { West—R. M. STEWART,  
 C. G. SMITH,  
 D. B. NUGENT.  
 East—C. A. FRENCH, in May,  
 W. C. JACQUES, in June.

DIFFERENCE OF LONGITUDE BETWEEN FORT FRANCES, ONT., AND DOMINION OBSERVATORY, OTTAWA.

| DATE.   | DIFFERENCE OF CHRONOGRAPH. |    |    |                  |   |    | DIFFERENCE OF LONGITUDE. |     |    |                  |    |     | Time of Trans- mission. |                  |    |     |                  |    |    |       |   |    |    |     |     |     |
|---------|----------------------------|----|----|------------------|---|----|--------------------------|-----|----|------------------|----|-----|-------------------------|------------------|----|-----|------------------|----|----|-------|---|----|----|-----|-----|-----|
|         | Western Signals.           |    |    | Eastern Signals. |   |    | Western Station.         |     |    | Eastern Station. |    |     |                         | Western Signals. |    |     | Eastern Signals. |    |    | Mean. | r |    |    |     |     |     |
|         | h                          | m  | s  | h                | m | s  | s                        | s   | s  | h                | m  | s   |                         | h                | m  | s   | h                | m  | s  |       |   |    |    |     |     |     |
| 1908.   |                            |    |    |                  |   |    |                          |     |    |                  |    |     |                         |                  |    |     |                  |    |    |       |   |    |    |     |     |     |
| June 24 | 1                          | 10 | 53 | 779              | 1 | 10 | 53                       | 544 | 15 | 299              | 16 | 265 | 1                       | 10               | 44 | 835 | 1                | 10 | 44 | 690   | 1 | 10 | 44 | 747 | 020 | 117 |
| " 25    | 1                          | 10 | 52 | 468              | 1 | 10 | 52                       | 230 | 13 | 949              | 6  | 338 | 1                       | 10               | 44 | 857 | 1                | 10 | 44 | 619   | 1 | 10 | 44 | 738 | 041 | 119 |
| " 26    | 1                          | 10 | 50 | 306              | 1 | 10 | 50                       | 055 | 11 | 973              | 6  | 049 | 1                       | 10               | 44 | 752 | 1                | 10 | 44 | 501   | 1 | 10 | 44 | 627 | 070 | 126 |
| " 27    | 1                          | 10 | 47 | 587              | 1 | 10 | 47                       | 306 | 9  | 227              | 16 | 553 | 1                       | 10               | 44 | 913 | 1                | 10 | 44 | 632   | 1 | 10 | 44 | 772 | 075 | 140 |
| " 28    | 1                          | 10 | 45 | 269              | 1 | 10 | 44                       | 967 | 7  | 120              | 16 | 662 | 1                       | 10               | 44 | 751 | 1                | 10 | 44 | 509   | 1 | 10 | 44 | 630 | 067 | 121 |

Observers: West—F. A. McDIARMID, D. B. NUGENT, C. C. SMITH.  
 East—R. M. STEWART, D. B. NUGENT, C. C. SMITH.

dA . . . . . h m s  
 A Ottawa . . . . . 1 10 44 637  
 A Fort Frances . . . . . 5 02 51 797  
 . . . . . 6 13 36 494

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN TRURO, N. S., AND DOMINION OBSERVATORY, OTTAWA.

| DATE.   | DIFFERENCE OF CHRONOGRAPH. |        |                  |        | CLOCK CORRECTION. |        |                  |        | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Transmission. |       |    |
|---------|----------------------------|--------|------------------|--------|-------------------|--------|------------------|--------|--------------------------|--------|------------------|--------|-----------------------|-------|----|
|         | Western Signals.           |        | Eastern Signals. |        | Western Station.  |        | Eastern Station. |        | Western Signals.         |        | Eastern Signals. |        |                       | Mean. | r. |
|         | m.                         | s.     | m.               | s.     | m.                | s.     | m.               | s.     | m.                       | s.     | m.               | s.     |                       |       |    |
| 1908.   |                            |        |                  |        |                   |        |                  |        |                          |        |                  |        |                       |       |    |
| June 29 | 50                         | 07.859 | 50               | 07.692 | 16.740            | 14.346 | 49               | 46.773 | 49                       | 46.696 | 49               | 46.690 | 064                   | 084   |    |
| " 30    | 50                         | 09.048 | 50               | 08.868 | 16.828            | 15.427 | 49               | 46.732 | 49                       | 46.692 | 49               | 46.687 | 057                   | 095   |    |
| July 1  | 50                         | 10.786 | 50               | 10.610 | 16.862            | 16.976 | 49               | 46.948 | 49                       | 46.772 | 49               | 46.860 | 106                   | 088   |    |
| " 4     | 50                         | 08.063 | 50               | 07.900 | 17.044            | 14.182 | 49               | 46.867 | 49                       | 46.674 | 49               | 46.771 | 017                   | 097   |    |

Observers { West—R. M. STEWART, D. B. NUGENT, C. C. SMITH.  
 East—W. C. JACQUES.

dA. . . . . h m s  
 A Ottawa . . . . . 49 46.754  
 A Truro . . . . . 5 02 51.797  
 A Time . . . . . 4 13 05.043

DIFFERENCE OF LONGITUDE BETWEEN NORTH LAKE, ONT., AND DOMINION OBSERVATORY, OTTAWA

| DATE.  | DIFFERENCE OF CHRONOMETER. |                  | CLOCK CORRECTION. |                  | DIFFERENCE OF LONGITUDE. |                  |       |        | Time of Trans-mission |        |    |        |     |     |
|--------|----------------------------|------------------|-------------------|------------------|--------------------------|------------------|-------|--------|-----------------------|--------|----|--------|-----|-----|
|        | GRADE.                     |                  | STATION.          |                  | SIGNALS.                 |                  | MEAN. |        |                       |        |    |        |     |     |
|        | Western Signals.           | Eastern Signals. | Western Station.  | Eastern Station. | Western Signals.         | Eastern Signals. | Mean. | Mean.  |                       |        |    |        |     |     |
| 1908.  | m.                         | s.               | m.                | s.               | m.                       | s.               | m.    | s.     | m.                    | s.     |    |        |     |     |
| July 1 | 58                         | 10 912           | 58                | 10 711           | 42 692                   | + 6 862          | 59    | 00 496 | 59                    | 00 295 | 59 | 00 395 | 088 | 100 |
| " 2    | 58                         | 10 603           | 58                | 10 390           | 42 885                   | + 6 920          | 59    | 00 408 | 59                    | 00 195 | 59 | 00 302 | 005 | 107 |
| " 3    | 58                         | 09 864           | 58                | 09 653           | 43 529                   | + 6 377          | 59    | 00 370 | 59                    | 00 159 | 59 | 00 265 | 012 | 106 |
| " 3    | 58                         | 09 547           | 58                | 09 327           | 43 843                   | + 6 487          | 59    | 00 377 | 59                    | 00 157 | 59 | 00 267 | 010 | 110 |

Observers ( West—E. A. McDIARMID,  
 East—C. C. SMITH, R. M. STEWARD.  
 d A  
 A Ottawa ..... 5 02 51.797  
 A North Lake ..... 6 01 52.101

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN NIPIGON, ONT., AND DOMINION OBSERVATORY, OTTAWA.

| Date.  | DIFFERENCE OF CHRONO-GRAPH. |        |                  |        | CLOCK CORRECTION. |        |                  |     | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Transmission. |        |     |
|--------|-----------------------------|--------|------------------|--------|-------------------|--------|------------------|-----|--------------------------|--------|------------------|--------|-----------------------|--------|-----|
|        | Western Signals.            |        | Eastern Signals. |        | Western Station.  |        | Eastern Station. |     | Western Signals.         |        | Eastern Signals. |        |                       | Mean.  | c.  |
|        | m.                          | s.     | m.               | s.     | m.                | s.     | m.               | s.  | m.                       | s.     | m.               | s.     |                       |        |     |
| 1908.  |                             |        |                  |        |                   |        |                  |     |                          |        |                  |        |                       |        |     |
| July 6 | 15                          | 57.414 | 15               | 56.886 | 1                 | 07.292 | 17               | 410 | 50                       | 11.126 | 50               | 11.198 | 50                    | 11.312 | 114 |
| " 7    | 15                          | 55.976 | 15               | 55.755 | -1                | 08.217 | 17               | 478 | 50                       | 11.401 | 50               | 11.180 | 50                    | 11.291 | 111 |
| " 8    | 15                          | 51.340 | 15               | 51.033 | -1                | 09.833 | 17               | 245 | 50                       | 11.418 | 50               | 11.171 | 50                    | 11.295 | 124 |

Observers { West—F. A. McDIARMID.  
 { East—C. C. SMITH.

d A ..... 50 11 299  
 A Ottawa ..... 5 02 51 797  
 A Nipigon ..... 5 53 03 696

DIFFERENCE OF LONGITUDE BETWEEN JACKFISH, ONT., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONO-GRAPH. |        | Clock Correction. |        | DIFFERENCE OF LONGITUDE. |       |                  |           | Time of Transmission. |
|---------|-----------------------------|--------|-------------------|--------|--------------------------|-------|------------------|-----------|-----------------------|
|         | Western Signals.            |        | Eastern Station.  |        | Western Signals.         |       | Eastern Signals. |           |                       |
|         | m.                          | s.     | m.                | s.     | m.                       | s.    | m.               | s.        |                       |
| 1908.   |                             |        |                   |        |                          |       |                  |           |                       |
| July 11 | 47                          | 32 453 | 45                | 32 280 | 138 013                  | 7 386 | 45 01 826        | 45 01 662 | 015                   |
| " 12    | 45                          | 31 514 | 45                | 31 294 | 137 117                  | 7 436 | 45 01 833        | 45 01 613 | 006                   |
| " 13    | 45                          | 30 882 | 45                | 30 650 | 136 491                  | 7 444 | 45 01 835        | 45 01 603 | 010                   |

Observers: (West—F. A. McDIARMID,  
 (East—D. B. NUGENT, R. M. STEWART.

d A ... .. h. m. s.  
 A Ottawa ... .. 5 02 51.797  
 A Jackfish ... .. 5 47 53.526



SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN HALIFAX, N.S. AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONO-GRAPH. |        | CLOCK CORRECTION. |        | DIFFERENCE OF LONGITUDE. |    |                  |    | Time of Transmission. |       |        |      |     |
|---------|-----------------------------|--------|-------------------|--------|--------------------------|----|------------------|----|-----------------------|-------|--------|------|-----|
|         | Western Signals.            |        | Eastern Station.  |        | Western Signals.         |    | Eastern Signals. |    |                       | Mean. |        |      |     |
|         | m.                          | s.     | m.                | s.     | m.                       | s. | m.               | s. |                       |       |        |      |     |
| 1908.   |                             |        |                   |        |                          |    |                  |    |                       |       |        |      |     |
| July 23 | 50                          | 38.372 | 50                | 38.124 | +7.622                   | -2 | 03.504           | 48 | 27.216                | 48    | 27.122 | 009  | 124 |
| " 24    | 50                          | 39.629 | 50                | 39.434 | +7.612                   | 2  | 04.785           | 48 | 27.232                | 48    | 27.134 | -021 | 037 |
| " 26    | 48                          | 37.904 | 48                | 37.715 | +7.603                   | 01 | 220              | 48 | 27.181                | 48    | 27.087 | 026  | 035 |
| " 28    | 48                          | 39.992 | 48                | 39.806 | +7.269                   | 05 | 475              | 48 | 27.218                | 48    | 27.125 | 112  | 063 |
| " 29    | 48                          | 40.655 | 48                | 40.495 | +7.267                   | 06 | 211              | 48 | 27.177                | 48    | 27.097 | 016  | 086 |

Observers: (West - C. C. SMITH, D. B. NUGENT, R. M. STEWART. (East - W. C. JACQUES.

d A . . . . . h. m. s. 48 27 112  
 A Ottawa . . . . . 5 02 51.797  
 A Halifax. . . . . 4 14 24.684

DIFFERENCE OF LONGITUDE BETWEEN MATHESON, ONT., AND DOMINION OBSERVATORY, OTTAWA

| Date.             | DIFFERENCE OF CHRONOGRAPH. |        |                  |        | CLOCK CORRECTION. |        |                  |     | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Trans- mission. |        |      |
|-------------------|----------------------------|--------|------------------|--------|-------------------|--------|------------------|-----|--------------------------|--------|------------------|--------|-------------------------|--------|------|
|                   | Western Signals.           |        | Eastern Signals. |        | Western Station.  |        | Eastern Station. |     | Western Signals.         |        | Eastern Signals. |        |                         | Mean.  |      |
|                   | m                          | s      | m                | s      | m                 | s      | m                | s   | m                        | s      | m                | s      |                         |        |      |
| 1908.             |                            |        |                  |        |                   |        |                  |     |                          |        |                  |        |                         |        |      |
| July 22 . . . . . | 20                         | 16 678 | 20               | 16 573 | 11                | 24 351 | 17               | 633 | 18                       | 59 957 | 18               | 59 862 | 18                      | 59 901 | 038  |
| " 23 . . . . .    | 20                         | 14 994 | 20               | 14 809 | 11                | 22 712 | 17               | 622 | 18                       | 59 901 | 18               | 59 719 | 18                      | 59 810 | 056  |
| " 24 . . . . .    | 20                         | 13 231 | 20               | 13 016 | 11                | 20 883 | 17               | 612 | 18                       | 59 960 | 18               | 59 755 | 18                      | 59 868 | 002  |
| " 25 . . . . .    | 20                         | 11 010 | 20               | 10 861 | 11                | 18 585 | 17               | 575 | 18                       | 60 000 | 18               | 59 851 | 18                      | 59 927 | 061  |
| " 26 . . . . .    | 20                         | 08 557 | 20               | 08 389 | 11                | 16 157 | 17               | 503 | 18                       | 59 903 | 18               | 59 755 | 18                      | 59 819 | -017 |

Observers: West—F. A. McDIARMID.  
 East—C. C. SMITH.  
 East (R. M. STEWART.

d A . . . . . h m s  
 A Ottawa . . . . . 5 02 51 866  
 A Matheson . . . . . 5 21 51 663

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN NEWCASTLE, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date   | DIFFERENCE OF CHRONOGRAPH. |                  | CLOCK CORRECTION. |                  | DIFFERENCE OF LONGITUDE. |                  |           |          | Time of Trans- mission. |
|--------|----------------------------|------------------|-------------------|------------------|--------------------------|------------------|-----------|----------|-------------------------|
|        | Western Signals.           | Eastern Signals. | Western Station.  | Eastern Station. | Western Signals.         | Eastern Signals. | Mean.     | <i>t</i> |                         |
|        | m                          | s                | m                 | s                | m                        | s                | m         | s        | s                       |
| 1908.  |                            |                  |                   |                  |                          |                  |           |          |                         |
| Aug. 3 | 40 35.246                  | 40 35.107        | + 7.506           | + 6.129          | 40 33.869                | 40 33.730        | 40 33.800 | 054      | 070                     |
| " 9    | 40 45.609                  | 40 44.932        | + 7.997           | + 3.209          | 40 33.884                | 40 33.726        | 40 33.805 | 059      | 079                     |
| " 10   | 40 46.183                  | 40 43.393        | + 8.061           | + 4.361          | 40 33.763                | 40 33.371        | 40 33.667 | 079      | 096                     |
| " 11   | 40 47.287                  | 40 47.113        | + 8.124           | + 5.335          | 40 33.828                | 40 33.651        | 40 33.741 | 065      | 087                     |
| " 15   | 40 52.983                  | 40 52.794        | + 8.322           | + 10.794         | 40 33.867                | 40 33.678        | 40 33.773 | 027      | 095                     |
| " 16   | 40 53.190                  | 40 52.995        | + 8.365           | + 11.037         | 40 33.788                | 40 33.593        | 40 33.691 | 055      | 098                     |

*d* N. . . . . h m s  
 " Ottawa. . . . . 5 02 33.746  
 " Newcastle. . . . . 4 22 18.061

Observers: West—R. M. STEWART, C. C. SMITH, D. B. NUENT.  
 " East—W. C. JAQUES.

DIFFERENCE OF LONGITUDE BETWEEN MEGANTIC, QUE., AND DOMINION OBSERVATORY, OTTAWA.

| DATE.  | DIFFERENCE OF CHRONOGRAPH. |    |                  |    | CLOCK CORRECTION. |     |                  |     | DIFFERENCE OF LONGITUDE. |    |                  |    | Time of days mission. |       |    |    |     |     |
|--------|----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|----|------------------|----|-----------------------|-------|----|----|-----|-----|
|        | Western Signals.           |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |    | Eastern Signals. |    |                       | Mean. |    |    |     |     |
|        | m                          | s  | m                | s  | m                 | s   | m                | s   | m                        | s  | m                | s  |                       | m     | s  |    |     |     |
| 1908.  |                            |    |                  |    |                   |     |                  |     |                          |    |                  |    |                       |       |    |    |     |     |
| Aug. 4 | 18                         | 26 | 401              | 18 | 26                | 271 | 17               | 608 | 19                       | 19 | 733              | 19 | 19                    | 600   | 19 | 19 | 677 | 048 |
| " 7    | 18                         | 34 | 469              | 18 | 34                | 348 | 17               | 730 | 19                       | 19 | 815              | 19 | 19                    | 694   | 19 | 19 | 754 | 029 |
| " 8    | 18                         | 36 | 718              | 18 | 36                | 650 | 17               | 893 | 19                       | 19 | 823              | 19 | 19                    | 757   | 19 | 19 | 791 | 031 |
| " 9    | 18                         | 39 | 317              | 18 | 39                | 204 | 17               | 997 | 19                       | 19 | 782              | 19 | 19                    | 639   | 19 | 19 | 710 | 015 |
| " 10   | 18                         | 41 | 573              | 18 | 41                | 438 | 18               | 060 | 19                       | 19 | 758              | 19 | 19                    | 623   | 19 | 19 | 681 | 031 |

West—R. M. STEWART, C. C. SMITH, D. B. NUGENT.  
 East—F. A. McDIARMID.

d A. . . . .  
 \ OTTAWA . . . . .  
 \ MEGANTIC . . . . .

h m s  
 19 19 725  
 5 02 51 797  
 1 43 32 072

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN BLACK LAKE, QUE., AND DOMINION OBSERVATORY, OTTAWA.

| DATE.   | DIFFERENCE OF CHRONOGRAPH. |        |                  |        | CLOCK CORRECTION. |         |                  |        | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Transmission. |        |   |     |     |
|---------|----------------------------|--------|------------------|--------|-------------------|---------|------------------|--------|--------------------------|--------|------------------|--------|-----------------------|--------|---|-----|-----|
|         | Western Signals.           |        | Eastern Signals. |        | Western Station.  |         | Eastern Station. |        | Western Signals.         |        | Eastern Signals. |        |                       | Mean.  |   |     |     |
|         | m                          | s      | m                | s      | m                 | s       | m                | s      | m                        | s      | m                | s      |                       | m      | s |     |     |
| 1908.   |                            |        |                  |        |                   |         |                  |        |                          |        |                  |        |                       |        |   |     |     |
| Aug. 11 | 18                         | 39 886 | 18               | 39 761 | +8 124            | -55 479 | 17               | 27 283 | 17                       | 27 158 | 17               | 27 321 | 17                    | 27 221 | - | 009 | 063 |
| " 14    | 18                         | 36 997 | 18               | 36 838 | +8 295            | -61 370 | 17               | 27 382 | 17                       | 27 173 | 17               | 27 252 | 17                    | 27 252 | - | 022 | 079 |
| " 15    | 18                         | 38 713 | 18               | 38 571 | +8 322            | -63 085 | 17               | 27 306 | 17                       | 27 164 | 17               | 27 235 | 17                    | 27 235 | - | 005 | 071 |
| " 16    | 18                         | 39 541 | 18               | 39 422 | +8 365            | -63 905 | 17               | 27 271 | 17                       | 27 152 | 17               | 27 212 | 17                    | 27 212 | - | 018 | 060 |

Observers: West—D. B. NUGENT, C. C. SMITH.  
 East—F. A. McDIARMID.

d A..... h m s  
 A Ottawa..... 5 02 51 797  
 A Black Lake..... 4 45 24 567

DIFFERENCE OF LONGITUDE BETWEEN FOSTER, QUE., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONO-GRAPH. |                  | CLOCK CORRECTION. |                  | DIFFERENCE OF LONGITUDE. |                  |           |      | Time of Trans- mission. |
|---------|-----------------------------|------------------|-------------------|------------------|--------------------------|------------------|-----------|------|-------------------------|
|         | Western Signals.            | Eastern Signals. | Western Station.  | Eastern Station. | Western Signals.         | Eastern Signals. | Mean.     | E.   |                         |
| 1908.   | m. s.                       | m. s.            | s.                | s.               | m. s.                    | m. s.            | m. s.     | s.   | s.                      |
| Aug. 17 | 13 34 669                   | 13 34 598        | + 8 408           | -33 484          | 12 52 777                | 12 52 706        | 12 52 742 | -011 | 036                     |
| " 18    | 13 36 882                   | 13 36 260        | + 8 413           | 35 147           | 12 52 772                | 12 52 690        | 12 52 731 | 000  | 041                     |
| " 19    | 13 37 618                   | 13 37 546        | + 8 529           | 36 332           | 12 52 757                | 12 52 685        | 12 52 721 | -010 | 036                     |

A Ottawa ..... 5 02 51 797  
 A Foster ..... 4 49 59 066  
 h. m. s.

Observers: West—C. C. SMITH, D. B. NICHOLSON.  
 East—F. A. McDIARMID.

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN BOIESTOWN, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONO-GRAPH. |        |                  |        | CLOCK CORRECTION. |          |                  |        | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Transmission. |        |     |     |  |
|---------|-----------------------------|--------|------------------|--------|-------------------|----------|------------------|--------|--------------------------|--------|------------------|--------|-----------------------|--------|-----|-----|--|
|         | Western Signals.            |        | Eastern Signals. |        | Western Station.  |          | Eastern Station. |        | Western Signals.         |        | Eastern Signals. |        |                       | Mean.  |     |     |  |
|         | m.                          | s.     | m.               | s.     | s.                | s.       | m.               | s.     | m.                       | s.     | m.               | s.     |                       | m.     | s.  |     |  |
| 1 08.   |                             |        |                  |        |                   |          |                  |        |                          |        |                  |        |                       |        |     |     |  |
| Aug. 20 | 37                          | 27 414 | 37               | 27 220 | + 8 569           | 08 003   | 37               | 10 842 | 37                       | 10 648 | 37               | 10 745 | 37                    | 10 745 | 014 | 087 |  |
| " 21    | 37                          | 27 398 | 37               | 27 220 | + 8 610           | - 07 916 | 37               | 10 872 | 37                       | 10 694 | 37               | 10 783 | 37                    | 10 783 | 006 | 089 |  |
| " 23    | 37                          | 29 731 | 37               | 29 560 | + 8 642           | - 10 154 | 37               | 10 945 | 37                       | 10 764 | 37               | 10 854 | 37                    | 10 854 | 005 | 090 |  |
| " 24    | 37                          | 30 028 | 37               | 29 882 | + 8 718           | - 10 461 | 37               | 10 846 | 37                       | 10 700 | 37               | 10 773 | 37                    | 10 773 | 016 | 073 |  |

d A ..... h. m. s.  
 A Ottawa ..... 37 10 789  
 A Boiestown ..... 5 02 51 797  
 ..... 4 25 41 008

Observers: West—D. B. NUGENT, C. C. SMITH, R. M. STEWART.  
 East—W. C. JAGUES.

DIFFERENCE OF LONGITUDE BETWEEN WOODSTOCK, N.B. AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOMETER. |        | CLOCK CORRECTION. |                  | DIFFERENCE OF LONGITUDE. |        |    |                  | Time of Transmission. |        |     |     |
|---------|----------------------------|--------|-------------------|------------------|--------------------------|--------|----|------------------|-----------------------|--------|-----|-----|
|         | GRAPH.                     |        | Western Station.  | Eastern Station. | Western Signals.         | Mean.  |    | Eastern Signals. |                       |        |     |     |
|         | m.                         | s.     | m.                | s.               | m.                       | s.     | m. | s.               |                       |        |     |     |
| 1908.   |                            |        |                   |                  |                          |        |    |                  |                       |        |     |     |
| Aug. 23 | 28                         | 32 513 | 18 612            | 11 09 028        | 32                       | 32 809 | 32 | 32 666           | 32                    | 32 783 | 065 | 117 |
| " 24    | 28                         | 33 028 | 18 717            | 11 08 377        | 32                       | 32 891 | 32 | 32 688           | 32                    | 32 791 | 013 | 103 |
| " 25    | 28                         | 33 843 | 18 778            | 11 07 896        | 32                       | 32 871 | 32 | 32 648           | 32                    | 32 760 | 018 | 112 |

d A ..... h. m. s.  
 A Ottawa ..... 32 32 778  
 A Woodstock ..... 5 02 51 797

OBSERVERS: ( West—R. M. STEWART, C. G. SMITH, D. B. NUGENT.  
 East—F. A. McDERMID.



SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN ST. HYACINTHE, QUE. AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONO-GRAPH. |    |                  |    | CLOCK CORRECTION. |     |                  |     | DIFFERENCE OF LONGITUDE. |    |                  |    | Time of Transmission. |       |    |    |     |    |    |     |     |     |
|---------|-----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|----|------------------|----|-----------------------|-------|----|----|-----|----|----|-----|-----|-----|
|         | Western Signals.            |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |    | Eastern Signals. |    |                       | Mean. | r. |    |     |    |    |     |     |     |
|         | m.                          | s. | m.               | s. | m.                | s.  | m.               | s.  | m.                       | s. | m.               | s. |                       |       |    |    |     |    |    |     |     |     |
| 1908.   |                             |    |                  |    |                   |     |                  |     |                          |    |                  |    |                       |       |    |    |     |    |    |     |     |     |
| Aug. 27 | 12                          | 37 | 553              | 12 | 37                | 580 | +8               | 804 | 1                        | 21 | 387              | 11 | 07                    | 462   | 11 | 07 | 389 | 11 | 07 | 426 | 081 | 087 |
| " 28    | 12                          | 38 | 846              | 12 | 38                | 748 | +8               | 807 | 1                        | 22 | 530              | 11 | 07                    | 479   | 11 | 07 | 411 | 11 | 07 | 445 | 012 | 034 |
| " 30    | 12                          | 12 | 103              | 12 | 12                | 036 | +8               | 837 | 1                        | 25 | 733              | 11 | 07                    | 533   | 11 | 07 | 456 | 11 | 07 | 499 | 012 | 033 |

h. m. s.

d A Ottawa 11 07 437  
 A St. Hyacinthe 5 02 51 797  
 A St. Hyacinthe 4 51 41 340

Observers: (West) D. B. NUGENT, C. C. SMITH, R. M. STEWART.  
 (East) F. A. McDIARMID.

DIFFERENCE OF LONGITUDE BETWEEN FREDERICTON, N. B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOGRAPH. |        | Clock Correction. |        | DIFFERENCE OF LONGITUDE. |         |                  |        |       |        | Time of Transmission. |        |      |     |
|---------|----------------------------|--------|-------------------|--------|--------------------------|---------|------------------|--------|-------|--------|-----------------------|--------|------|-----|
|         | Western Signals.           |        | Eastern Station.  |        | Western Signals.         |         | Eastern Signals. |        | Mean. |        |                       | C.     |      |     |
|         | m.                         | s.     | h.                | s.     | m.                       | s.      | m.               | s.     | m.    | s.     |                       |        |      |     |
| Aug. 28 | 36                         | 21 603 | 36                | 24 438 | + 8 807                  | + 2 544 | 36               | 18 340 | 36    | 18 175 | 36                    | 18 258 | 0 10 | 083 |
| " 29    | 36                         | 25 485 | 36                | 29 327 | + 8 822                  | + 1 597 | 36               | 18 260 | 36    | 18 102 | 36                    | 18 181 | 0 07 | 079 |
| " 30    | 36                         | 26 489 | 36                | 29 370 | + 8 837                  | + 0 615 | 36               | 18 267 | 36    | 18 148 | 36                    | 18 207 | 0 11 | 079 |
| " 31    | 36                         | 27 449 | 36                | 27 300 | + 8 876                  | 0 335   | 36               | 18 238 | 36    | 18 089 | 36                    | 18 164 | 0 04 | 075 |
| Sept. 1 | 36                         | 28 746 | 36                | 28 598 | + 8 914                  | 1 469   | 36               | 18 363 | 36    | 18 215 | 36                    | 18 289 | 0 07 | 074 |
| " 3     | 36                         | 31 437 | 36                | 31 304 | + 8 989                  | 4 171   | 36               | 18 277 | 36    | 18 144 | 36                    | 18 211 | 0 07 | 067 |

Observers: West—C. C. SMITH, D. B. NUGENT, R. M. STEWART.  
 East—W. C. JAQUES.

at A. . . . . h. m. s.  
 A Ottawa . . . . . 5 02 51 797  
 A Fredericton . . . . . 1 36 33 579

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN SOREL, QUE., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOGRAPH. |                  | CLOCK CORRECTION. |                  | DIFFERENCE OF LONGITUDE. |                  |           |       | Time of Trans- mission. |
|---------|----------------------------|------------------|-------------------|------------------|--------------------------|------------------|-----------|-------|-------------------------|
|         | Western Signals.           | Eastern Signals. | Western Station.  | Eastern Station. | Western Signals.         | Eastern Signals. | Mean.     | F     |                         |
| 1908.   | m.                         | s.               | m.                | s.               | m.                       | s.               | m.        | s.    |                         |
| Aug. 31 | 10 35 736                  | 10 35 677        | 4 8 876           | 2 701            | 10 24 159                | 10 24 160        | 10 24 130 | ..... | 030                     |
| Sept. 1 | 10 37 589                  | 10 37 467        | 4 8 914           | 4 473            | 10 24 122                | 10 24 080        | 10 24 101 | ..... | 031                     |
| " 2     | 10 30 562                  | 10 39 513        | 4 8 351           | 5 494            | 10 24 117                | 10 24 068        | 10 24 093 | ..... | 025                     |
| " 3     | 10 40 755                  | 10 40 733        | 4 8 989           | 7 661            | 10 24 105                | 10 24 083        | 10 24 094 | ..... | 011                     |

Observers: West—C. C. SMITH, D. B. NOBENT.  
 East—F. A. McDIARMID.

d A ..... 10 24 107  
 A Ottawa ..... 5 02 51 797  
 A Soré ..... 4 52 27 630

DIFFERENCE OF LONGITUDE BETWEEN ST. JEROME, QUE., AND DOMINION OBSERVATORY, OTTAWA

| DATE.   | DIFFERENCE OF CHRONOGRAPH. |        |                  |        | CLOCK CORRECTION. |         |                  |         | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Transmission. |        |       |      |
|---------|----------------------------|--------|------------------|--------|-------------------|---------|------------------|---------|--------------------------|--------|------------------|--------|-----------------------|--------|-------|------|
|         | Western Signals.           |        | Eastern Signals. |        | Western Station.  |         | Eastern Station. |         | Western Signals.         |        | Eastern Signals. |        |                       | Mean.  |       |      |
|         | m.                         | s.     | m.               | s.     | m.                | s.      | m.               | s.      | m.                       | s.     | m.               | s.     |                       | m.     | s.    |      |
| 1908.   |                            |        |                  |        |                   |         |                  |         |                          |        |                  |        |                       |        |       |      |
| Sept. 4 | 7                          | 13.199 | 7                | 13.091 |                   | + 9.052 |                  | -12.194 | 6                        | 51.953 | 6                | 51.845 | 6                     | 51.899 | 0.81  | 0.54 |
| " 5     | 7                          | 14.187 | 7                | 14.070 |                   | + 9.078 |                  | -13.087 | 6                        | 52.022 | 6                | 51.905 | 6                     | 51.963 | 0.20  | 0.58 |
| " 6     | 7                          | 16.010 | 7                | 15.890 |                   | + 9.081 |                  | 14.781  | 6                        | 52.148 | 6                | 52.028 | 6                     | 52.088 | 0.105 | 0.60 |

Observers: West—C. C. SMITH, D. B. NUGENT, R. M. STEWART.  
 East—F. A. MCDIARMID.

d A. . . . . h. m. s.  
 A Ottawa . . . . . 5 02 51.797  
 A St. Jerome . . . . . 4 55 59.814

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN RIVIERE DU LOUP STATION., QUE., AND DOMINION OBSERVATORY, OTTAWA.

| DATE.  | DIFFERENCE OF CHRONOGRAPH. |    | CLOCK CORRECTION. |    | DIFFERENCE OF LONGITUDE. |    |                  |     | Time of Transmission. |       |     |     |     |
|--------|----------------------------|----|-------------------|----|--------------------------|----|------------------|-----|-----------------------|-------|-----|-----|-----|
|        | Western Signals.           |    | Eastern Station.  |    | Western Signals.         |    | Eastern Signals. |     |                       | Mean. | s.  |     |     |
|        | h.                         | m. | s.                | s. | h.                       | m. | s.               | h.  |                       |       |     | m.  | s.  |
| 1908.  |                            |    |                   |    |                          |    |                  |     |                       |       |     |     |     |
| Sept 8 | 24                         | 57 | 827               | 03 | 086                      | 24 | 45               | 673 | 24                    | 45    | 611 | 024 | 062 |
| " 9    | 24                         | 58 | 117               | 03 | 237                      | 24 | 45               | 725 | 24                    | 45    | 624 | 24  | 030 |
| " 10   | 25                         | 00 | 211               | 05 | 236                      | 24 | 45               | 763 | 24                    | 45    | 655 | 24  | 054 |
| " 11   | 25                         | 01 | 650               | 06 | 574                      | 24 | 45               | 693 | 24                    | 45    | 600 | 24  | 047 |
| " 12   | 25                         | 02 | 291               | 07 | 258                      | 24 | 45               | 645 | 24                    | 45    | 529 | 24  | 058 |
| " 13   | 25                         | 03 | 351               | 08 | 478                      | 24 | 45               | 646 | 24                    | 45    | 513 | 24  | 067 |

Observers: West D. B. NUGENT, C. C. SMITH.  
East W. C. JACQUES.

of A. . . . . h. m. s.  
A Ottawa . . . . . 5 02 51 797  
A Rivière du Loup Station . . . . . 4 38 06 162

DIFFERENCE OF LONGITUDE BETWEEN EDMUNDSTON, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.        | DIFFERENCE OF CHRONO-GRAPH. |    |                  |    | CLOCK CORRECTION. |     |                  |     | DIFFERENCE OF LONGITUDE. |     |                  |    | Time of Transmission. |       |    |     |     |     |
|--------------|-----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|-----|------------------|----|-----------------------|-------|----|-----|-----|-----|
|              | Western Signals.            |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |     | Eastern Signals. |    |                       | Mean. |    |     |     |     |
|              | m.                          | s. | m.               | s. | s.                | s.  | s.               | s.  | m.                       | s.  | m.               | s. |                       |       |    |     |     |     |
| 1908.        |                             |    |                  |    |                   |     |                  |     |                          |     |                  |    |                       |       |    |     |     |     |
| September 19 | 29                          | 46 | 024              | 29 | 46                | 516 | 19               | 680 | 03                       | 297 | 29               | 33 | 539                   | 29    | 33 | 595 | 075 | 054 |
| " 20         | 29                          | 41 | 051              | 29 | 43                | 950 | 19               | 627 | 00                       | 708 | 29               | 33 | 615                   | 29    | 33 | 665 | 001 | 050 |
| " 22         | 29                          | 42 | 765              | 29 | 42                | 636 | 19               | 651 | 100                      | 021 | 29               | 33 | 653                   | 29    | 33 | 687 | 021 | 031 |
| " 23         | 29                          | 42 | 736              | 29 | 42                | 615 | 19               | 678 | 100                      | 706 | 29               | 33 | 673                   | 29    | 33 | 718 | 052 | 015 |

Observers: West—D. B. NUGENT, R. M. STEWART, C. C. SMITH.  
 East—W. C. JACQUES.

d A ..... h. m. s. 29 33 666  
 A Ottawa ..... 5 02 54.797  
 A Edmundston..... 4 33 18.131

SESSIONAL PAPER No. 25a

DIFFERENCE OF LONGITUDE BETWEEN PERCÉ, QUE., AND DOMINION OBSERVATORY, OTTAWA.

| Date.      | DIFFERENCE OF CHRONO-GRAPH. |        | CLOCK CORRECTION. |        | DIFFERENCE OF LONGITUDE. |        |                  |        | Time of Trans- mission. |        |     |     |
|------------|-----------------------------|--------|-------------------|--------|--------------------------|--------|------------------|--------|-------------------------|--------|-----|-----|
|            | Western Signals.            |        | Eastern Station.  |        | Western Signals.         |        | Eastern Signals. |        |                         | Mean.  | r.  |     |
|            | m.                          | s.     | s.                | s.     | m.                       | s.     | m.               | s.     |                         |        |     |     |
| 1908.      |                             |        |                   |        |                          |        |                  |        |                         |        |     |     |
| October 5. | 46                          | 00 841 | 46                | 00 632 | +10 660                  | +8 512 | 45               | 59 303 | 45                      | 59 199 | 017 | 105 |
| " 6.       | 46                          | 00 161 | 45                | 59 965 | +10 072                  | +9 215 | 45               | 59 291 | 45                      | 59 291 | 019 | 103 |
| " 7.       | 45                          | 59 686 | 45                | 59 456 | +10 078                  | +9 661 | 45               | 59 252 | 45                      | 59 117 | 055 | 105 |

Observers: West—C. C. SMITH, D. B. NUGENT.  
 East—W. C. JACQUES.

h. m. s.  
 A. . . . . 45 59 182  
 A Ottawa . . . . . 5 02 51 797  
 A Percé . . . . . 4 16 52 615

DIFFERENCE OF LONGITUDE BETWEEN CAMPBELLTON, N.B., AND DOMINION OBSERVATORY, OTTAWA.

| Date.   | DIFFERENCE OF CHRONOGRAPH. |    |                  |    | CLOCK CORRECTION. |     |                  |     | DIFFERENCE OF LONGITUDE. |      |                  |    | Time of Trans mission. |       |    |    |     |    |    |     |     |     |
|---------|----------------------------|----|------------------|----|-------------------|-----|------------------|-----|--------------------------|------|------------------|----|------------------------|-------|----|----|-----|----|----|-----|-----|-----|
|         | Western Signals.           |    | Eastern Signals. |    | Western Station.  |     | Eastern Station. |     | Western Signals.         |      | Eastern Signals. |    |                        | Mean. |    |    |     |    |    |     |     |     |
|         | m                          | s  | m                | s  | m                 | s   | m                | s   | m                        | s    | m                | s  |                        | m     | s  |    |     |    |    |     |     |     |
| 1908.   |                            |    |                  |    |                   |     |                  |     |                          |      |                  |    |                        |       |    |    |     |    |    |     |     |     |
| Oct. 10 | 36                         | 42 | 680              | 36 | 42                | 550 | + 42             | 351 |                          | 9    | 842              | 36 | 10                     | 171   | 36 | 10 | 041 | 36 | 10 | 106 | 057 |     |
| " 12    | 35                         | 56 | 874              | 35 | 56                | 700 |                  | 00  | 382                      | + 13 | 711              | 36 | 10                     | 193   | 36 | 10 | 019 | 36 | 10 | 106 | 057 | 065 |
| " 13    | 35                         | 54 | 320              | 35 | 54                | 149 |                  | 00  | 407                      | + 16 | 422              | 36 | 10                     | 335   | 36 | 10 | 164 | 36 | 10 | 250 | 087 | 085 |
| " 14    | 35                         | 53 | 385              | 35 | 53                | 808 |                  | 00  | 400                      | + 16 | 753              | 36 | 10                     | 278   | 36 | 10 | 161 | 36 | 10 | 189 | 026 | 085 |

Observers: West—C. C. SMITH, R. M. STEWART, D. B. NUENT.  
East.—W. C. JACQUES.

d A . . . . . h m s  
 A Ottawa . . . . . 5 02 51.797  
 A Campbellton . . . . . 4 26 41.634



SESSIONAL PAPER No. 25a

LONGITUDE AND LATITUDE OF STATIONS OBSERVED IN 1908.

| Place.                       | Difference of Longitude. | To                        | Longitude.  |              | Longitude.  |     | Latitude. |  |
|------------------------------|--------------------------|---------------------------|-------------|--------------|-------------|-----|-----------|--|
|                              |                          |                           | h. m. s.    | " "          | " "         | " " |           |  |
| Gateway.....                 | 28 39 199                | Seattle.....              | 7 40 41.075 | 115 10 16 13 | 48 59 58.45 |     |           |  |
| Boundary (Waneta).....       | 18 49 289                | ".....                    | 7 50 30.985 | 117 37 44 78 | 49 00 00.51 |     |           |  |
| St. John.....                | 58 35 784                | Dominion Observatory..... | 4 24 16.013 | 66 04 00 20  | 45 16 35.04 |     |           |  |
| Spokane.....                 | 1 19 41 5689             | ".....                    | 6 22 33.366 | 95 38 20 49  | 49 02 05 10 |     |           |  |
| Rainy River.....             | 1 15 21 072              | ".....                    | 6 18 15.869 | 94 33 58 04  | 48 43 22 80 |     |           |  |
| Moncton.....                 | 43 42 653                | ".....                    | 4 19 09 741 | 64 47 26 16  | 46 05 02 21 |     |           |  |
| Fort Frances.....            | 1 10 44 697              | ".....                    | 6 13 36 494 | 93 24 07 41  | 48 36 48 50 |     |           |  |
| Truro.....                   | 49 46 754                | ".....                    | 4 13 03 043 | 63 16 15 65  | 45 21 47 32 |     |           |  |
| North Lake.....              | 59 00 307                | ".....                    | 6 01 52 104 | 90 28 01 36  | 48 08 28 17 |     |           |  |
| Nijiga.....                  | 50 11 299                | ".....                    | 5 53 03 096 | 86 58 22 89  | 49 00 43 75 |     |           |  |
| Jackfish.....                | 45 01 729                | ".....                    | 5 47 53 526 | 86 58 22 89  | 48 47 44 84 |     |           |  |
| Halifax.....                 | 48 27 113                | ".....                    | 4 14 24 684 | 63 36 10 26  | 44 40 07 52 |     |           |  |
| Matheson.....                | 18 39 866                | ".....                    | 4 21 51 665 | 80 27 54 05  | 48 32 07 23 |     |           |  |
| Newcastle.....               | 40 33 746                | ".....                    | 4 22 18 051 | 65 34 30 77  | 47 00 11 37 |     |           |  |
| Megantic.....                | 19 19 725                | ".....                    | 4 43 32 072 | 70 53 01 08  | 45 34 32 80 |     |           |  |
| Black Lake.....              | 17 27 259                | ".....                    | 4 45 24 567 | 71 21 08 51  | 46 02 44 50 |     |           |  |
| Foster.....                  | 32 52 731                | ".....                    | 4 49 50 066 | 72 29 45 90  | 45 17 14 63 |     |           |  |
| Bateson.....                 | 37 10 789                | ".....                    | 4 25 41 008 | 66 25 15 12  | 46 08 33 28 |     |           |  |
| Woodstock.....               | 32 32 775                | ".....                    | 4 50 19 049 | 67 34 45 25  | 46 08 33 28 |     |           |  |
| St. Hyacinthe.....           | 11 07 457                | ".....                    | 4 51 44 340 | 72 56 05 10  | 45 57 15 28 |     |           |  |
| Fredonction.....             | 36 18 218                | ".....                    | 4 26 33 579 | 66 38 23 69  | 45 57 41 50 |     |           |  |
| Scard.....                   | 10 24 107                | ".....                    | 4 52 27 690 | 73 06 55 35  | 46 02 19 50 |     |           |  |
| St. Jerome.....              | 6 51 985                 | ".....                    | 4 55 59 814 | 73 59 57 21  | 45 46 33 20 |     |           |  |
| Riviere du Loup Station..... | 24 45 635                | ".....                    | 4 38 06 162 | 69 31 32 43  | 47 49 23 48 |     |           |  |
| Edmundston.....              | 29 33 656                | ".....                    | 4 33 18 131 | 68 19 31 97  | 47 22 06 65 |     |           |  |
| Perce.....                   | 45 59 152                | ".....                    | 4 16 52 615 | 64 15 09 23  | 48 50 52 05 |     |           |  |
| Campbellton.....             | 36 10 165                | ".....                    | 4 26 41 634 | 66 40 24 51  | 48 00 31 33 |     |           |  |

## LOCAL POSITIONS OF ASTRONOMICAL STATIONS.

*Gateway.*—The pier is on the international boundary line 189.4 feet due east of boundary monument No. 244, and is 541.3 feet west of United States survey post No. 25104 on boundary line.

*Boundary (Waneta).*—The pier is 24.5 feet due east of monument No. 181 on the international boundary line.

*St. John.*—The pier is 82 feet north and 174 feet west of the northeast corner of Lombard and Southwork streets. Reference point is southeast corner of I.C.R. grain elevator. Reference angle  $188^{\circ} 44'$  right from meridian at centre of pier to reference point. Distance, 196.8 feet.

*Sprague.*—The pier is 670.7 feet west and 1.4 feet north of the southwest corner of the Canadian Northern Railway station house.

*Rainy River.*—The pier is 111.2 feet north, and 51.3 feet west of the southwest corner of 3rd street and Atwood ave.

*Moncton.*—Reference point is the northwest corner of the Interecolonial Railway blacksmith shop. N.  $52^{\circ} 16'$  E. from meridian through centre of pier. Distance, 1.378 chains.

*Fort Frances.*—The pier is 9.7 feet north and 189.2 feet east of the northeast corner of 4th street and Cornwall ave.

*Truro.*—The pier is 49.49 feet east and 64.13 feet south of gas-pipe marking the boundary of the I.C.R. yard at head of Miller street and Mr. Fraser's gate.

*North Lake.*—The pier is 272.5 feet east and 15.5 south of 'frog' lying between the Port Arthur and Duluth Railway main line and the southwest leg of the 'Y.'

*Nipigon.*—The pier is 47.8 feet west and 82.4 feet north of the northwest corner of the Canadian Pacific Railway station house.

*Jackfish.*—The pier is 228.5 feet north and 82.9 feet west of the southwest corner of the Canadian Pacific Railway station house.

*Halifax.*—The pier is 127.26 feet east and 90.38 feet north of the southeast corner of Creighton & Co.'s grocery store. It is also 63.23 feet east and 54.04 feet south of the gas pipe marking the boundary of the I.C.R. yard. Direction of said pipe from pier being  $54^{\circ} 15'$  from the meridian measured from the north through the west.

*Matheson.*—The pier is on the right of way of the Timiskaming and Northern Ontario Railway, and is 153.5 feet south and 178.0 feet east of the northeast corner of 5th ave. and Railway street.

*Newcastle.*—The pier is 14.16 feet east and 90.66 feet south of the intersection of Station and Gene streets.

*Megantic.*—The pier is 172.5 feet east and 72.6 feet north of the southwest corner of Maple ave. and McCauley street.

*Black Lake.*—The pier is 111.1 feet east and 190.8 feet north of the northwest corner of Whitney ave. and the private way of the American Asbestos Company.

*Foster.*—The pier is 181.5 feet north and 480.3 feet west of the middle point of the crossing of the Boltón Road and the Canadian Pacific Railway main line (Foster crossing). The pier is about 80 feet north of the Canadian Pacific Railway station house.

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*Boiestown.*—The pier is 41.63 feet east and 99.87 feet north from the northeast corner of T. Lynch & Co.'s supply store.

*Woodstock.*—The pier is 432.5 feet east and 100 feet south of the northeast corner of George and Main streets.

*St. Hyacinthe.*—The pier is 85 feet east and 516 feet north of the middle point of the crossing of Broadway Road and the Canadian Pacific Railway main line, and is about 400 feet from the station house.

*Fredericton.*—The pier is on the river front 52.15 feet north and 97.0 feet west of the northwest corner of Lamont's furniture warehouse at the corner of Regent and Campbell streets.

*Sorel.*—The pier is 191.9 feet west and 51.2 feet north of the southeast corner of Ray and Victoria streets.

*St. Jerome.*—The pier is 412.0 feet east and 102.4 feet south of the southeast corner of St. Antoine and St. Anne streets. It is on the Canadian Pacific Railway right of way about 400 feet south of the station house.

*Rivière du Loup Station.*—The pier is 511.5 feet from the southeast corner of the I.C.R. machine shop. Angle from the north through the west  $41^{\circ} 54'$ .

*Edmundston.*—The pier is 148.30 feet east and 12.04 feet north of the northeast corner of Temiscouata Railway station.

*Percé.*—The pier is 84.63 feet west and 72.28 feet south of the southwest corner of Abraham Lenfesty's house.

*Campbellton.*—The pier is 18.27 feet east and 12.41 feet south of the southeast corner of the post office building.

*Dominion Observatory.*—The reference point of the longitude observed in 1908 is a temporary transit house, the meridian of which is  $0^{\circ} 12'$  east of the centre of the dome of the Observatory.

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